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NEW SERIES, NO. 149 (VOL. XX) MARCH, 1925

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

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THE STATISTICIAN AND THE POPULATION PROBLEM[1]

BY LOUIS I. DUBLIN, *Statistician, Metropolitan Life Insurance Company, New York*[2]

It is highly gratifying that the three societies meeting here tonight, all dedicated to the social sciences, are concerning themselves more and more with live issues and are devoting their energies to the solution of practical questions of the day. Our membership, still largely composed of teachers and men of science, is to that extent cloistered and somewhat out of touch with the actual affairs of business and of politics. But so important have been the contributions of our members, that keen business men and administrators are learning to rely on them for guidance. This is, of course, as it should be. Everywhere, we see the close association of large business ventures with the best scientific thought of the country. The economist, the sociologist and the statistician, as well as the psychologist, the biologist and the chemist, are often the only ones able to solve the technical and even the practical problems that come up in the efficient conduct of business. It is consequently becoming more common for financiers, manufacturers, statesmen and administrators of public affairs to consult with those who have made special studies of the intricacies of social life, and to formulate their programs in line with the counsel given. Through the channels of the newspaper, the magazine, and the forum, such as this, public opinion is being molded and social policies are being built upon a sound foundation of fact. The social sciences are decidedly coming into their own; their scope is expanding and a brilliant future is in store for them.

Under these conditions it is particularly fitting that the American

[1] Address of the President delivered at the Annual Meeting of the American Statistical Association, Chicago, Illinois, December 29, 1924.

[2] The writer gratefully acknowledges his obligation to Miss Bessie Bunzel, M.A., of the Statistical Bureau of the Metropolitan Life Insurance Company for her assistance in the preparation of this address and for her efficient management of the many details of the annual program of the Association.

Statistical Association should have chosen for discussion the population problem, which is today the most vital in American life. Perhaps no other question has developed such a variety of opinion or aroused greater antagonisms and prejudices. Certainly none partakes of greater national and international significance. The World War was essentially an expression of the population problem confronting the nations of Europe ten years ago. The crowding of the peoples of Central Europe was undoubtedly one of the underlying causes of the war. Each country needed room for expansion and desired additional markets and colonies where surplus peoples could be accommodated and food could be raised for the use of the homeland. Germany more than any other country was striving for a place in the sun and found her borders shadowed on the one hand by France and on the other by Russia. To make matters worse, she felt a sense of superiority to France whose population she had far outstripped in numbers. The year 1914 seemed an opportune time to strike for more territory. The fears engendered in France and Russia by an ever-growing Germany contributed to a state of mind which made war inevitable. This is an outstanding example of an almost universal condition. In the Balkan countries, the same situation prevailed; each dreamed of a greater Greece, or Bulgaria, or Roumania, as the case might be, which could only be realized at the expense of a neighboring country. In Japan the pressure of population on the island kingdom has been intense and accounts for its desire to spread out to unsettled areas near at hand and to seize opportunities for migration to America and especially to Australia. This has produced hostile reactions in Australia, the United States, and South America, who have closed their doors against the Japanese. Such suspicions and recriminations are responsible for the rapid growth of the war spirit.

These are instances of the sinister international aspect of the population problem. But, within individual countries the population problem often takes on queer expression in an exaggerated feeling of nationalism and exclusiveness. In the United States it has given rise to two movements: first, the new immigration policy, and second, the Ku Klux Klan. Essentially, both are an expression of a similar psychology. They express the point of view of a great mass of native Americans in all parts of the country, which may be summed up in the slogan "America for Americans." What underlies these phenomena is, first of all, a distrust of the newcomer, resentment at his success, and the fear engendered by his greater fertility and rapid increase in numbers after his arrival. The adherents of the Klan see themselves losing control of the country. Their formation of an organized group, then,

is really the expression of a defense reaction to the passing away of power from their own hands and its concentration in that of aliens whom they consider inferior, or, in any case, unable to conduct properly the affairs of the country. Essentially the same reasoning is at the bottom of the new immigration law which admits into the country only a limited number of aliens selected from the few countries whose peoples and standards of life most closely resemble our own. The stream of papers and books in recent years which has crystallized into an organized propaganda for the Nordic races in America is simply an effort to give the appearance of respectability and of science to what is fundamentally an expression of unreasoned prejudice.

Such sentiments and passions often lead, as we have seen, to hastily considered legislation. Laws based not on accurate information or calm, logical reasoning, are passed only to be later repealed after irreparable damage has been done. Had the statistician been consulted in the first place, much of this futility could have been averted. His function is primarily to get the facts, to analyze them, to weigh their relative importance, and then to arrive at a conclusion based upon the evidence. From the beginning, the study of population has been the statistician's special concern. In fact, he made his first real contribution in this field and thus earned his name. For was not the "Statist" at the end of the eighteenth century the man who concerned himself with the affairs of the State, who made inquiries respecting populations, the production and resources of the country, who recorded and organized available knowledge describing the human beings of the state? If anyone can solve such an intricate social problem, it should be the statistician who, after two centuries of study, can be expected to make a contribution of the first rank to this vexing question, and introduce order, logic, and understanding where now only confusion reigns.

The population question, important everywhere, is today most pressing in the United States. The problem in the countries of Europe and Asia is acute enough; but the issue is clearer, because those parts of the world have practically reached a saturation point and possess in most cases a population fairly homogeneous with reference to blood and culture. In this country, the future is still in the making. It is not too much to say that the hope of the world rests on a happy and successful solution of our population question. Canada, Australia and the South American states are facing much the same problem as we are, and any conclusions we may reach will be of great value to them also.

The population problem of the United States has two main aspects;

the first quantitative, and the second qualitative. Under the first is implied an understanding of the facts of our population both from the point of view of structure and of movement, in the past and currently. It presupposes a consideration of the possibilities of future growth; the determination of the maximum numbers which can be supported, and when this figure is likely to be reached. Our discussion must include also the relationship between the increase in numbers and the natural resources of the country—agricultural, mineral and littoral. All of these factors are considered in the first two sessions of our program.

Under the second or qualitative aspect of our discussion we are thinking about such elements as the present constitution of the country racially; the contribution which the various racial stocks have made to our common cultural life; and our attitude regarding the future composition of the country. This involves the discussion of a rational immigration policy which is the main subject of our third session. There is, however, another consideration which is neither exclusively quantitative nor purely qualitative in character but partakes of both and must receive very careful consideration. Our future well-being will depend upon the standards of life we desire, upon the efficiency with which we manage our resources, and upon the efficient training and direction of our labor supply with due regard to the utilization of the labor of the women and children. These questions are considered in our fourth session.

Our final meeting seeks to formulate a program, outline a technique and present a goal for the future. We will attempt to sketch the type of civilization that we may hope to achieve; its internal economic and social organization; the composition and organization of the family unit. We must endeavor to understand how the age at marriage will influence the size of the family; the part played by schooling and training; what conditions best enable the individual to cope with his environment; what vocational equipment is necessary; whether the public health movement and the improvement in environmental conditions have contributed to an increase of the weaklings of society; whether our vast system of charitable and poor relief has only served to provide a cheap but inadequate labor supply. We must seek constantly to keep in touch with the facts as they develop from day to day, so that we may always gauge the changes that occur, and determine whether we are working towards our objective or have deviated from it; we must decide in what direction we are going, and to what ultimate end. Our fifth session should in this way develop a clearer methodology for the study of the population problem of the future.

These are the elements which compose our program. As you see,

our discussions will branch out into every field of science and draw upon the entire body of existing knowledge. But it is impossible in a limited number of sessions to cover all the ramifications of the population problem. No reference will be made, for example, to the most important and perplexing problem presented by the presence of the Negro in the American population. This subject would itself justify a full symposium and we have, therefore, thought best not to raise the issue at all by giving it only scant consideration. And there are other phases of the population problem which we have likewise omitted.

It is a pleasure at this time to acknowledge the enthusiastic support of all the scientists participating in our program; and it is particularly gratifying to find that our society could, at short notice, produce from its own ranks so many men admirably qualified to treat such a variety of topics in an authoritative manner. We have demonstrated in the formation of this program that it is possible for students in various branches of scientific research to get together and coöperate in the advancement of knowledge and its application to social problems. The combined result of our symposium should produce a work on population worthy of the American Statistical Association, and one so obviously reliable that it must surely influence current public opinion. Our efforts have been materially stimulated by the early offer of the Pollak Foundation which promises to issue as a volume of their publications the papers read here.

Our speakers will present a wide variety of views and give their personal interpretation of the facts. This is no cut and dried affair reflecting one man's judgment. The freest play of opinion has been encouraged, because we clearly realize that the population problem still involves many uncertain factors. There are still too many non-statistical elements complicating the picture, which may at any moment call for a very different approach to all population estimates. A realization of any one of a number of experiments now being conducted in the laboratories of the chemists and physicists to produce synthetically some of our common foodstuffs, such as sugar, would revolutionize our whole social economy and throw into a cocked hat all previous estimates of an optimum population. At all events, the subject has not yet reached a point where definite and immutable laws can be established. We can, however, ferret out the facts in the case, and give to those best qualified to speak, an opportunity to present them. Our hope is that the various contributions may be sufficiently interrelated to form a more or less continuous, coherent and convincing story.

One would think that having arranged such a program, your President would more or less gracefully pass into the background and leave the discussion to those chosen to consider specific topics. I had at first wished to do so; but, on consideration, have decided to participate, if only mildly. Certain phases of our problem have interested me for years—and it is hard to resist the opportunity to join such an excellent company. I will, however, not discuss any one major subject. My effort will be to present a few comments on methodology and attempt to supply a unifying principle which will coördinate our many-sided discussion.

The first point I wish to make is to warn against the error of generalizing from crude and temporary relationships. A number of American statisticians have assumed that the future growth of the country will keep pace with the increase in past decades without giving due consideration of the underlying factors which have caused that increase. This has led them to forecast future populations of enormous size which at an early date would tax the very limits of our natural resources. No wonder, therefore, that they are pessimistic and urge the most drastic limitation of immigration and restriction of our fecundity. What items have they overlooked? Professor Willcox, from a critical analysis of American population statistics, infers that a natural decline in the native American birth rate began as early as 1810 and that it has continued since that time.[1] At any rate it is certain that there has been a long continued decrease. This decline has received very little attention because it has not stood out clearly, its effects having been covered up partly by the improvement in mortality, and partly by the immigration movement. The very large increase in our numbers which has characterized the past fifty years has been due in a large measure to immigration and to the results of immigration. In 1920, the foreign-born whites constituted 13 per cent of the population. Since 1900, well over sixteen million foreigners have come here—the gross immigration averaging over a million each year for the five years ending June 1914. Not only must we count the total number of newcomers admitted into the country, but we must realize that they come from fertile peoples accustomed for centuries to large families, and that coming here, for the most part, during their reproductive years, they have produced large numbers of offspring soon after their arrival. Accordingly, we find in 1920 that the native-born of foreign parentage constituted 14.8 per cent (in addition to the 13 per cent mentioned

[1] Walter F. Willcox: "The Changes in the Proportion of Children in the United States and in the Birth Rate in France in the Nineteenth Century," JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION, Vol. XII: March, 1911, pp. 490–499.

above) and the native-born of mixed parentage another 6.6 per cent. This makes the foreign stock in 1920 over a third of the total population of the country.

Today, the picture is on the way to being completely changed. The recent restrictions on immigration will take good care that our future increase of population will not come from that source. More and more, it will result from the excess of births over deaths in the native-born population; and, if present indications are any guide, the phenomenal growth of the past will never again be repeated. Already in 1920, the native stock residing in the urban areas was scarcely replacing itself the country over. There are also clear indications that among the foreign stock the size of the families varies in direct proportion with the length of time they have lived in the United States. With immigration restricted, every population forecast that I know must be revised with due regard to the relative fecundity of stocks now composing the American population. We shall, therefore, be confronted with the reality of a stationary population much sooner than any of our forecasters have imagined.

My second comment is to advise against easy solutions of the population problem. Those who have been most distressed by the rapid increase in our population in recent decades have, for the most part, urged the more general practice of birth control, which has seemed to them the simplest and most direct way out of our trouble. To discuss in detail the subject of birth control would take more time than I have at my disposal, and some of its phases at least will be considered by others. I desire only to show how dangerous are the implications in this panacea. The assumption seems to be that birth control is a new force which would substitute order and intelligence for the present haphazard and indiscriminate growth of population. But, the facts appear to be otherwise. The practice of birth control is nothing new; nor has it been limited to one group of people, namely, the better circumstanced. In no other way can we account for the rapid decline in the birth rate in the United States—and in other countries. It was over 30 per thousand only fifteen years ago in those American cities which kept accurate figures; it is now little over 20. This represents a drop of 30 per cent during a period of generally increasing prosperity, of rising wages, and of other favorable factors which ordinarily increase the birth rate. Every doctor, every nurse, and every social worker knows how powerful is the force of birth control among the American people at the present time. The researches of Miss Katherine B. Davis, Professor Cattell, and others, demonstrate this fully. Birth control is nothing new in American life. It has been for years and is

increasingly today the established practice among city dwellers who belong to the salaried classes. It must, therefore, be considered in our discussion frankly and fully and its effects must be carefully weighed and determined before it receives further sanction from presumably authoritative sources.

The recent change in our immigration laws, on the one hand, and the practice of birth control, on the other, will very soon produce a population situation essentially different from that of the last generation. We must be prepared at a comparatively early date for a stationary population unless we completely change our present attitude toward the foreigner and modify our approval of small families. Such a reversal is not likely to take place, because we like, as a nation, to indulge our sense of exclusiveness and superiority. Moreover, giving birth to a very few children apparently offers many personal advantages and appeals to the average family, which is much more concerned with the immediate increase of comfort than with abstract principles of obligation to country or to mankind in general. We may, therefore, expect current tendencies to become more fixed and intensified and to find that we will before long approach the condition of a stationary population.

It will clarify our discussion at this point if we consider the number of births that it requires under present conditions of mortality to keep a population stationary. According to the mortality and marital conditions prevailing in 1920, out of every thousand females born, 788 will eventually marry. In other words, we must count on 788 married women to give birth to a thousand daughters in order to replace the thousand from which they sprang. To put it another way, a thousand married women must have 1,268 daughters to replace themselves under present mortality conditions. Likewise, it can be shown that a thousand married men must be the fathers of 1,350 sons in order to replace themselves. Combining our figures, we find that one thousand families, on the average, must have 2,618 children, which means that each family must, on the average, during the reproductive period, produce 2.6 children to replace the original quota from which the parents sprang. Not all families have children, however; for, at the present time, about one marriage in six is either sterile or does not lead to live issue. The burden of child-bearing, therefore, falls on the remaining families, who must bring into the world an average of not 2.6, but 3.1 children. The family unit, must, therefore, average 5.1 persons (including all the children born to fertile mothers, not merely the children living at any given moment). All groups of *urban* American families recently studied have shown that the average number of

children born to a completed marriage is barely sufficient to maintain a stationary population. It is only when the rural areas of the country are included that the figures show a substantial natural increase.

Dr. Lotka, the distinguished mathematician in my office, and I, have recently made an excursion into this field and have uncovered a number of highly interesting and even surprising situations. As the result of the higher birth rates of past generations there is at the present time an abnormally large number of persons at the reproductive ages of life, and this tends to increase the current birth rate. We have calculated what the present birth rate would be if the age distribution at the reproductive ages were the result of a prolonged continuation of our present rate of procreation (that is, births per annum, per potential mother of a given age). The effect would be to reduce the figure from 23.4 per 1,000, the present figure, to 20.9. In other words, what maintains for the time being our birth rate is not our inherently high reproductive vitality, but rather the fact that the surviving descendants of a more highly reproductive generation are today swelling the ranks of middle life and participating in parenthood. They thus lend a spurious appearance of vigorous growth to an otherwise meagerly reproducing population. At the same time a second result of this padding is to reduce the death rate disproportionately, because the ages of early adult life have very low mortality rates. If the correction were made for an age distribution on the basis of the present life table and the present rate of procreation, the death rate, instead of being 12.4, as it is now, would become 15.3. The effect of these two corrections would be to reduce the rate of natural increase from 11 per thousand to only 5.5 per thousand per annum, that is, to reduce it to one half of its present value. This means that, aside from the transitory benefits of *past* high birth rates which for a while we are still enjoying, we are actually increasing at the rate of only 5.5 per thousand per annum, instead of at a rate of 11 per thousand, per annum. Equally interesting is the result of our investigation into the effect of the recent improvement in mortality. The last five or ten years have seen a marked diminution in mortality rates, which has had the effect of increasing the rate of natural increase. If we should calculate the rate of natural increase of our population at our present rate of procreation and at the mortality rate of 1910, the result would be a rate of natural increase of only 3.6 per thousand per annum; and if we should go back to the mortality conditions of 1901, the present rate of procreation would barely keep us from the down-grade. The rate of natural increase would then be reduced to virtually zero. We should

then have a condition of a stationary population. These figures bring home clearly how close to the danger line we are now going.

We must exercise particular care, as we approach the point of a stationary population, not to weaken its internal composition by increasing the proportion of defective stock. This is all the more important because a stationary population inevitably contains a relatively greater number of older persons than a growing population. The support of these more advanced age groups falls in part upon the young people, who must, therefore, face the prospect, in coming years, of carrying a greater burden than has fallen to their share in the past. We are here confronted with a vicious circle; for the greater the burden placed on young people, the fewer will be their children, and this will mean still fewer young people at the reproductive period in the next generation. If a population can increase in a geometric ratio, it can also decrease in the same ratio. This is the real danger.

Probably nothing that we can do will alter the tendency among the great mass of Americans to reduce the size of their families. Reproduction will, hereafter, be more and more determined by intelligence and restraint. Excessive breeding should receive scant approval anywhere. We must aim at this time not for numbers at the expense of quality; but rather seek to develop a well-organized and happy society. That is the objective which should animate every student of population, every statesman and every thoughtful citizen. We must be careful, however, about the way we take to arrive at this goal. Merely wiping out our natural increase by the first means at hand will not do it. We must not substitute real and serious troubles of a new sort for minor and even imaginary old ones. We must not, above all, forget that population mistakes are not easily remedied; that when they are once made and their effects have become visible, it is usually too late to correct them.

Thus far, we have considered the quantitative aspect of the population problem. When we turn to the qualitative side of the question, there are just as many misconceptions rife in our current thinking. My third suggestion, therefore, toward a unified theory of population, is that our approach be democratic and not aristocratic in character. It has been fashionable in recent years to lament the non-fertility of the native stock and the fecundity of the newcomer. It has been assumed that the older races and especially those of Nordic origin are innately superior. The contributions of the various race stocks to our American life will be discussed by the anthropologists participating in our program. I desire only at this point to sound a warning against too ready acceptance of a theory which establishes sharp class distinctions with-

out sufficient scientific proof. Certainly at the present time, evidence is hardly sufficient to warrant the sweeping conclusion that certain racial elements in our national life are vastly superior to others.

Reflecting very much the same aristocratic bias of which I have spoken is the current view, especially pronounced among biological writers on population, that the country is headed for disaster because of the greater fertility of the "masses" as contrasted with that of the "classes." The literature associated with the eugenic movement has overstressed the dangers implied in the differential birth rate. "Beware of reproducing from mediocrity," is the warning. There is often a thinly disguised plea for a race of supermen who, presumably, could spring only from the upper social and economic strata. The common man has little place in this scheme of things, although he does, after all, make up the bulk of the population. This basic assumption should be thoroughly tested, even though its acceptance does flatter our self-esteem and reflect the paganism of our times. I seriously question its validity and consider this attitude a very crude and unjustified application of biological jargon to human life. Its chief defect lies in its almost total disregard of the influence of environment and tradition on our conduct and achievement. It is, moreover, a direct challenge to our best ideals of democracy and religion. When we have eliminated the upper and lower 10 per cent of our population, there is not sufficient indication of serious differences in innate ability among the remaining 80 per cent to justify the current fears and warnings against their deliberate participation in parenthood. They are neither spectacularly able nor do they abound in defects. If they lack the brilliance which would single them out for special distinction, they have usually other compensating, valuable and attractive qualities. They are just plain folks carrying on the world's work. We see on all sides clear evidence of the ability of ordinary people to give birth to children capable of the highest achievements as opportunity and environment release their power. Our social organization by its very complexities and the perfection of its mechanical foundations, is conducive to stimulating the innate abilities of men from all walks of life, which in a less well-organized society might go to waste. Throughout all ages the leaders of mankind have come predominantly from homes which at first sight seemed most unpromising and commonplace. Will not the leadership of the next generation come, as it always has in the past, from that source?

For these reasons, I consider the newer tendencies and movements in the American population far from inimical to our institutions and to the best traditions of the country. If we can be careful to control,

or better yet entirely check, the reproduction of the obviously unfit, we are in no danger of racial deterioration. There has always been a differential birth rate and a replacement of one group of people above, by another equally good from below. In all ages, men have raised themselves above their inherited station in life and have occupied the seats of the mighty, left vacant by those considered their superiors who have neglected, or have been incapable of performing their highest obligation to society, namely, parenthood. I make no pretense at having solved this difficult problem; but we must in all fairness examine critically the current point of view and shift the emphasis in our population discussion from a glorification of the upper strata to a more generous recognition of the inherent worth of the great mass of mankind.

In the last analysis, the contribution of the statistician to the population question must square with common sense and with the best traditions of our country and our times.

A MOVING SECULAR TREND AND MOVING INTEGRATION [1]

By Lincoln W. Hall, *University of Pennsylvania*

In the measurement of cyclical fluctuations the first step is the extraction of the element of secular trend from the original data. This is usually done by fitting a straight line to the data and then subtracting the ordinates given by the equation of this straight line from the corresponding items of original data.

This method serves the purpose when it is only desired to calculate cyclical fluctuations during a past period of time. For historical purposes the method seems adequate. Considerable difficulty is encountered, however, when current calculations are attempted. In order to obtain the cyclical fluctuations present in current data it is necessary to first obtain the element of secular trend which may be present. Therefore the knowledge which is obtained concerning the cycle which is in progress at the present time will depend largely upon the ability to calculate the element of secular trend in the data which represents economic events which have just occurred.

Professor Persons, writing in the *Harvard Review of Economic Statistics*, expresses the problem thus: "In order to interpret current data it was found necessary to estimate the level of prices. . . . The trend thus found is, frankly, a forecast which will be revised as new data become available." [2]

"It is obvious that neither the pre-war linear trend nor the linear trend of prices during the last three or four years can be used as a base line when measuring cyclical fluctuations, because *the extension of such trends into future years cannot be justified.* Likewise the use of more complicated mathematical curves is unsatisfactory." [3]

Professor Persons attempts to eliminate the element of secular trend by forming a series of ratios between two similar and homogeneous series of data. One of the series of data used is supposed to be more sensitive to cyclical fluctuations than the other series. Since the two series are similar and homogeneous, they are assumed to have approximately the same secular trends and therefore their ratios will contain little or no element of secular trend but only indications of cyclical fluctuations with possibly some element of seasonal variation.

[1] I am indebted to M. A. Brumbaugh of the University of Pennsylvania for a careful reading of the manuscript and for many valuable suggestions.

[2] *Harvard Review of Economic Statistics*, June, 1919 (supplement), p. 11.

[3] *Ibid.*, July, 1923, p. 191.

The Brookmire Economic Service also attempts to eliminate secular trend from current data by the use of ratios of series which are assumed to have approximately the same secular trends.[1]

Of course this method of eliminating secular trend by the use of ratios should prove useful in current calculations as long as the secular trends of the two series remain approximately the same. The principal difficulty of the method is that it lacks generality of application. The method requires that two series be found whose secular trend ordinates are not only approximately equal or proportional but which shall remain approximately equal or proportional. This condition is difficult to meet and no doubt in many cases it will be found impossible. A method to be of the greatest use should be generally applicable to any and all economic time series, and also allow any series to be currently analyzed with its secular, seasonal and cyclical components.

It, therefore, seems desirable to attempt to devise a method for the current measurement of secular trend which will depend only upon the series being measured, and which will not involve the relation of this series to any other series. Also the method should enable any recent item of data to be separated into its secular, seasonal and cyclical components.

For this purpose it is proposed to use a moving secular trend. There is no theoretical reason to suppose that the secular trend of any series is a straight line, but the straight line is used because it seems to give satisfactory experimental results and has less computation than any other function. It is improbable that the secular trend is strictly a straight line because it is unlikely that any economic phenomena will be encountered which is growing or increasing at a constant rate. It is likely, however, that the secular trend is some form of the parabola, or possibly a group of short parabolas placed together end to end without any particular connection with each other. In other words, there is no theoretical reason for supposing that the secular trend is necessarily composed of one function which maintains one set form such as a single straight line or parabola, but there is evidence to show that the secular trend is a continuous function which can be represented only by a group of functions placed end to end and which have no necessary relation to each other, and which are the result of the course of economic events producing the series under observation.[2]

The moving secular trend involves an abandonment of the idea that the secular trend must necessarily be a continuous function of some

[1] R. Vance: *Business and Investment Forecasting*, pp. 84–89.

[2] See the writer's *A Study of the Cyclical Fluctuations Occurring in the National Banking System During the Years 1903 to 1921*, Chap. 3 for series where changes in secular trend occurred.

particular constant and a priori known form, and brings in the concept that the secular trend may be a continuous function the form of which we do not know and which can only be represented by a group of known functions.

Instead of calculating one equation of the form $y=mx+b$ and obtaining therefrom the ordinates of secular trend, which form of calculation shall hereafter be called the fixed trend, the moving secular trend requires the separate calculation of an equation of the form $y=mx+b$ for every ordinate of original data so that there are as many equations as ordinates.[1] Each equation, therefore, only contributes one ordinate to the secular trend. That ordinate is the last ordinate which would be calculated in fitting the straight line to any set of data. For example suppose there were 24 items of which it was desired to find the secular trend. Then the method of calculating a moving trend would be to select some number of items, say 4, and fit a straight line to items 1, 2, 3 and 4. After securing the equation, the ordinate corresponding to item 4, or the last item in the fit, would be calculated and this ordinate would be the ordinate of secular trend corresponding to item 4. In order to secure the secular trend corresponding to item 5, it would be necessary to fit a new straight line to items 2, 3, 4 and 5, and calculate the ordinate corresponding to item 5, and so on for all the other items. This means that each equation contributes only one point of secular trend and in the above example there would be 21 points computed from the original 24 items. In order to compute 24 points, 3 additional preceding points would be necessary.

In choosing 4 points to calculate the moving trend a definite length of time was fixed, which shall hereafter be called the period, and this same period was used throughout the calculations. Evidently any period can be chosen within the limits of the original data.

The straight lines used in the moving trend are fitted by the method of least squares and for the purpose of greater convenience in calculation and also to better enable a study of some of the properties of the moving trend, it seemed desirable to solve in general form for the two constants m and b occurring in each straight line computation.

$$m=\frac{n+1\Sigma(a_i s_i)-\Sigma a_i \Sigma s_i}{n+1\Sigma a_i^2-(\Sigma a_i)^2} \qquad i=0,\ 1,\ 2,\ \ldots\ n$$

$$b=\frac{\Sigma a_i^2 \Sigma s_i-\Sigma a_i \Sigma a_i s_i}{n+1\Sigma a_i^2-(\Sigma a_i)^2}$$

where a represents the counting of time and s is the item of original data.

[1] There would be little use in using some form of the parabola instead of a straight line since all parabolas approach a straight line when the period is short enough.

The question immediately arises in calculating the moving trend as to what period shall be used. It is evident that the shorter the period the more sensitive will the moving trend be to changes in secular trend, and in order to be useful for current calculation the moving trend must be sensitive to changes in the secular trend of the series. If the period is too short then the moving trend will yield primarily the cycles and not the trend. The period should be in years such as 1, 2, 3, 4, etc., years and not involve fractional years such as $3\frac{1}{2}$, $4\frac{1}{4}$, etc. This is necessary so that the seasonal variation, which has a period of one year, will tend to cancel out its influence.[1] The period should not be any shorter than the period of the cycle so that the cycle will tend to cancel out its influence. Since the period for the moving trend should be as short as possible so as to render it sensitive to changes, and since the period for the trend can't be any shorter than the period of the cycle, it would seem that the period of the cycle in whole years would best satisfy all conditions and should be chosen as the period for the moving trend.

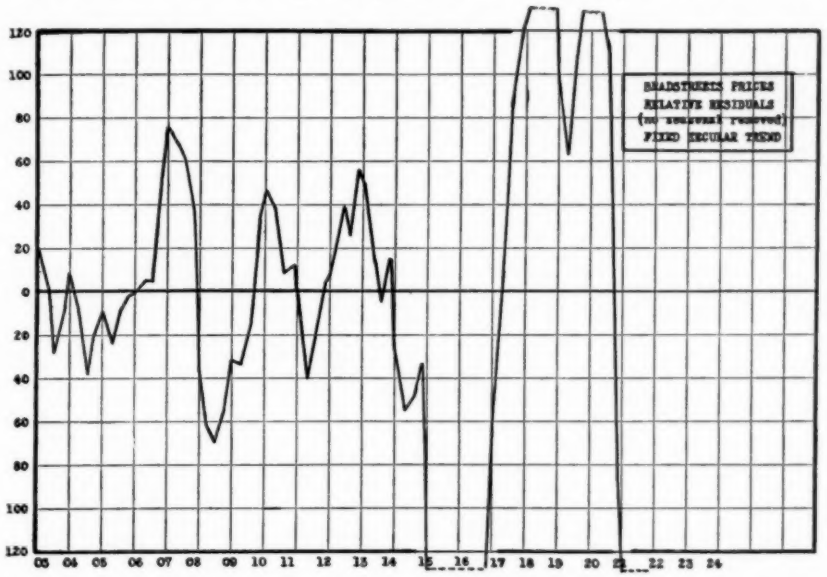
Some idea as to the change in sensitivity with the lengthening of the period may be gained from a study of the formulas for m and b. Since the only expressions which vary in these formulas are those containing s we can limit our attention to these expressions. It will be found that s appears for both m and b in only two expressions which are $\Sigma(a_i s_i)$ and Σs_i. Every other expression in the formulas is a constant for successive calculations when once the period has been chosen. Since successive changes in m and b can only be produced by changes in the expressions containing s the sensitivity of a particular period can be measured by the weight of the last s in producing changes in the value of the expressions containing s.

Since a_i in the expression $\Sigma(a_i s_i)$ represents the counting of time, a_i can be regarded as the weight of s_i on the sum, and therefore the weight of s_n or the last item of original data will be the ratio of a_n to the sum of all the a_i or $\frac{a_n}{\Sigma a_i}$. Thus using quarterly data the weight of s_n for a one year period is $\frac{1}{2}$, for a two year period $\frac{1}{4}$, for a three year period $\frac{1}{6}$, etc., so that the sequence corresponding to periods from one year up to n years is $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{6}$, . . . $\frac{1}{a+(n-1)d}$. For monthly data the general term should be multiplied by $\frac{1}{3}$. For Σs_i the weight of each s_i is the same as all the other s_i and therefore the weight of s_n is $\frac{1}{n+1}$.

[1] It is not necessary to observe this condition when the series under consideration has only a small amount of seasonal variation.

For purposes of illustration and experiment a series consisting of Bradstreet's Index of Prices was selected. The data was used on a quarterly basis and extends from the first quarter of 1903 to the second quarter of 1924. The cyclical fluctuations of this series were obtained by both the fixed trend and the moving trend and the results were compared.

The method of securing the cyclical fluctuations by use of the fixed



trend was to fit a straight line by least squares to the data from 1903 to 1914, and another separate straight line from 1915 to 1921. This was done because the secular trend of this series was evidently changing beginning with 1915. The cyclical fluctuations from the fixed trend were not obtained beyond 1921 since the fixed trend is not adaptable to approximately current data, particularly with a change in trend such as evidently occurred in 1921–1923.

The seasonal variation, which was obtained by taking seasonal means of the relative residuals,[1] was very small and had no significant effect in producing the cyclical fluctuation. For this reason the relative residuals were used directly as relative cyclical fluctuations without eliminating seasonal variation.

The period selected for the moving trend was three years. The reason for this selection was that three years is the nearest whole year period to the arithmetic average of the periods of the actual cycles

[1] See the writer's article this JOURNAL, June, 1924.

occurring from 1890 to 1921.[1] In this length of time there were supposed to have been 9 cycles and the mean cycle was $3\frac{1}{3}$ years. Also 7 out of the 9 cycles had periods closely grouped about 3 years, the other 2 cycles having periods of more than 4 years.[2]

There are two sources of error in the moving trend: first, if the assumed period of the trend differs from the actual period of the cycle then in progress, and second, if adjacent cycles through which the trend is passing have different amplitudes. Since the period of the trend will usually differ somewhat from the period of the cycle and the amplitudes of adjacent cycles are usually unequal, it is certain that the moving trend will usually contain some elements of error. Even though the errors may not be large enough to seriously distort the relative cyclical fluctuations, yet it is highly desirable to have an independent method of calculating current cycles so that the cyclical movements indicated by the use of the moving trend may be checked and verified. For this purpose a method has been devised by the use of moving integration.

The original data of any economic time series is some function of time, $f(t)$. This function could be integrated within definite limits and a definite integral secured, $\int_{k-a}^{k} f(t)dt$. However, when the form of the function is unknown and the original observed data is used instead, the process of integration, a process of infinitesimal differences, becomes summation, a process of finite differences. Therefore the definite integral $\int_{k-a}^{k} f(t)dt$ becomes $\sum_{i=k-a}^{i=k} x_i$ where x_i represents the original observed data. Hence this process of summation will be referred to as integration (where integration with finite differences is meant) and the results of the summation will be called integrals.

Since x is the original data,

$$x=u+v+w \text{ where } \begin{aligned} u &= \text{ordinate of secular trend} \\ v &= \text{“ “ seasonal variation} \\ w &= \text{“ “ cyclical fluctuation} \end{aligned}$$

If, considering quarterly data,[3] we integrate through a period of three years, we have

$$\sum_{i=k-11}^{i=k} x_i = \sum_{k-11}^{k} (u+v+w)_i = \sum_{k-11}^{k} u_i + \sum_{k-11}^{k} v_i + \sum_{k-11}^{k} w_i$$

[1] *Harvard Review of Economic Statistics*, January, 1923, article by Joseph Kitchin, p. 10.

[2] Three years may be regarded as the shortest period feasible for the use of the moving trend, although longer periods may be found to be more desirable. A period of four years or seven years might be found for certain purposes better than a three-year period.

[3] Conclusions not dependent on the use of quarterly data.

Since the seasonal variation v is presumed to be a periodic function with a period of one year, $\sum_{k-11}^{k} v_i = 0$. Similarly, if the period of the cycle was three years, then $\sum_{k-11}^{k} w_i = 0$. Since the period of the cycle is usually not three years, the above integral will not usually equal zero, but because the period of the cycle is close to three years, this integral will tend to equal or approximate zero. Assuming then that the above integrals of v and w approximately equal zero, or tend to cancel, $\sum_{k-11}^{k}(u+v+w)_i = \sum_{k-11}^{k} u_i$ which means that we have remaining a definite integral or summation of the ordinates of secular trend for three years.

In the same way $\sum_{k-10}^{k+1}(u+v+w)_i = \sum_{k-10}^{k+1} u_i$. Continuing this process we get a series of three-year definite integrals of secular trend

$$\sum_{k-11}^{k} u_i;\ \sum_{k-10}^{k+1} u_i;\ \sum_{k-9}^{k+2} u_i \ \ldots\ .$$

This process shall be called moving integration, and the integrals three-year moving integrals.[1]

If we integrate the original data through a one-year period, we have

$$\sum_{k-3}^{k} x_i = \sum_{k-3}^{k}(u+v+w)_i = \sum_{k-3}^{k} u_i + \sum_{k-3}^{k} v_i + \sum_{k-3}^{k} w_i$$

In this case the integral of v only will become zero and we have $\sum_{k-3}^{k}(u+w)_i$. If we continue this process as in the secular trend integrals, we secure a series of definite integrals of secular trend plus cyclical fluctuation

$$\sum_{k-3}^{k}(u+w)_i;\ \sum_{k-2}^{k+1}(u+w)_i;\ \sum_{k-1}^{k+2}(u+w)_i \ \ldots\ .$$

The moving integrals can be used effectively in obtaining a relative cycle (not the usual relative cycle which is relative of secular trend) direct from the original data without calculating the secular trend, seasonal variation, or cyclical fluctuation. For this purpose any mov-

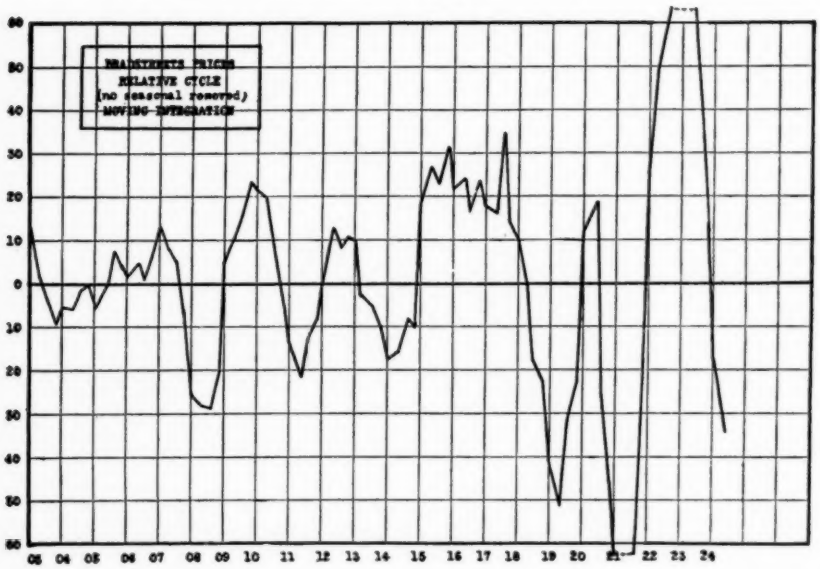
[1] See Karl G. Karsten: *The Theory of Quadrature in Economics;* this JOURNAL, March, 1924, for an interesting and enlightening discussion of integral curves and integration.

ing *three* year integral will be denoted by Σu_i and the immediately preceding integral by Σu_{i-1} so that

$$\sum_{k-10}^{k+1} u_i = \Sigma u_i \text{ and } \sum_{k-11}^{k} u_i = \Sigma u_{i-1}$$

The moving *one* year integral will be denoted by $\Sigma\ (u+w)_j$ and the immediately preceding integral by $\Sigma(u+w)_{j-1}$ so that

$$\sum_{k-2}^{k+1} (u+w)_i = \Sigma(u+w)_j \text{ and } \sum_{k-3}^{k} (u+w)_i = \Sigma(u+w)_{j-1}$$



A relative cycle can be obtained by first making chain indices of the three year integrals or $\frac{\Sigma u_i}{\Sigma u_{i-1}}$; second making chain indices of the one year integrals or $\frac{\Sigma(u+w)_j}{\Sigma(u+w)_{j-1}}$. Then $\frac{\Sigma(u+w)_j}{\Sigma(u+w)_{j-1}} - \frac{\Sigma u_i}{\Sigma u_{i-1}}$ will give a relative cycle which can be calculated currently as soon as the data is obtained.

Assuming that the seasonal variation and cyclical fluctuation do cancel out in accordance with the above argument (which is of course only approximately true), it is apparent that a source of error lies in the element of secular trend. In one part of the above formula the secular trend ordinates are summed for one year, and in another part they are summed for three years. For this reason and also in order to

determine what kind of a relative cycle we are obtaining, it is desirable to subject the formula to further analysis.

For convenience, we shall represent

Σu_i by u_i and Σu_{i-1} by u_{i-1}

also $\Sigma(u+w)_j$ or $\Sigma u_j+\Sigma w_j$ by $(u+w)_j$ or u_j+w_j

and $\Sigma(u+w)_{j-1}$ by $(u+w)_{j-1}$.

Then the above formula becomes $\dfrac{u_j+w_j}{u_{j-1}+w_{j-1}}-\dfrac{u_i}{u_{i-1}}$.

There are three possible cases: no secular trend (the slope of trend equals zero), a positive secular trend (the slope is greater than zero), and a negative secular trend (the slope less than zero).

Case 1. No Secular Trend. Since there is no secular trend, the slope is equal to zero and $u_i=u_{i-1}$, also $u_j=u_{j-1}$.

Then

$$\frac{u_j+w_j}{u_{j-1}+w_{j-1}}-\frac{u_i}{u_{i-1}}=\frac{u_j+w_j}{u_{j-1}+w_{j-1}}-1$$

$$=\frac{u_j+w_j-u_{j-1}-w_{j-1}}{u_{j-1}+w_{j-1}}=\frac{w_j-w_{j-1}}{u_{j-1}+w_{j-1}}.$$

It is seen from this last expression that the relative cycle which is obtained is the difference between the sum of the last four cyclical ordinates and the sum of the immediately preceding four cyclical ordinates as a relative of the sum of the four secular trend ordinates immediately preceding the last one plus the same four cyclical ordinates. It will be evident that the sign of this relative will depend on the numerator (which always depends on the movement of the cycle) since the denominator will be positive except in the remote case when the sum of the immediately preceding four cyclical ordinates is negative and greater than the sum of the same four secular trend ordinates. There is no error introduced in this case because of secular trend.

Case 2. A Positive Linear Trend. In this case the trend is assumed linear. Of course the secular trend is not always or even usually strictly linear, but the assumption of linearity does give us usually a close approximation.

m= constant slope of secular trend.

Then

$$\frac{u_j+w_j}{u_{j-1}+w_{j-1}}-\frac{u_i}{u_{i-1}}=\frac{u_{j-1}+4m+w_j}{u_{j-1}+w_{j-1}}-\frac{u_{i-1}+12m}{u_{i-1}}$$

$$=\frac{u_{j-1}+4m+w_j-u_{j-1}-w_{j-1}}{u_{j-1}+w_{j-1}}-\frac{12m}{u_{i-1}}$$

$$=\frac{w_j-w_{j-1}}{u_{j-1}+w_{j-1}}+\frac{12m}{3(u_{j-1}+w_{j-1})}-\frac{12m}{u_{i-1}}.$$

It is evident from the analysis that the errors introduced by the positive trend being $\frac{12m}{3(u_{j-1}+w_{j-1})}-\frac{12m}{u_{i-1}}$ tend to cancel. With a positive trend $3u_{j-1}>u_{i-1}$ and when w_{j-1} is either positive or zero, $\frac{12m}{u_{i-1}}>\frac{12m}{3(u_{j-1}+w_{j-1})}$ so that a negative bias is introduced which operates primarily to slightly diminish the positive phase of the cycle. When w_{j-1} is negative the error introduced by the positive secular trend tends to cancel, and except at the beginning there is probably little effect upon the negative phase of the cycle. A curvilinear trend would increase the bias somewhat, but in most series probably only slightly.

Case 3. A Negative Linear Trend.

$$\frac{u_j+w_j}{u_{j-1}+w_{j-1}}-\frac{u_i}{u_{i-1}}=\frac{u_{j-1}-4m+w_j}{u_{j-1}+w_{j-1}}-\frac{u_{i-1}-12m}{u_{i-1}}$$

$$=\frac{u_{j-1}-4m+w_j-u_{j-1}-w_{j-1}}{u_{j-1}+w_{j-1}}+\frac{12m}{u_{i-1}}$$

$$=\frac{w_j-w_{j-1}}{u_{j-1}+w_{j-1}}-\frac{12m}{3(u_{j-1}+w_{j-1})}+\frac{12m}{u_{i-1}}.$$

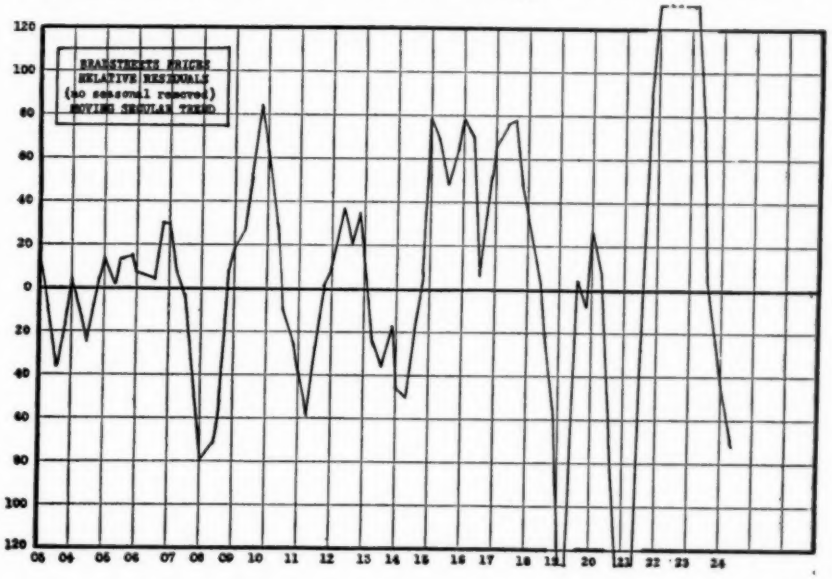
As in the positive trend the errors introduced by the negative trend tend to cancel. With a decreasing linear trend, $3u_{j-1}<u_{i-1}$, so that when w_{j-1} is negative or zero $\frac{12m}{3(u_{j-1}+w_{j-1})}>\frac{12m}{u_{i-1}}$ which again introduces a negative bias. This bias affects the negative phase of the cycle principally, serving to enhance it because when w_{j-1} is positive the error tends to cancel.

We now have two independent methods of calculating current relative cycles, by the use of a moving secular trend and by the use of moving integration. It now remains to compare the results obtained by using these two methods with the results obtained from the fixed trend on the series. The results are contained in the charts.

An examination of the charts will show that the results from the moving secular trend and moving integration methods are in close agreement. This fact adds considerable confidence in the reliability of the current cycle changes as they are shown by these two methods. When the moving calculations are compared with the fixed trend calculations, it is seen that they disagree somewhat in 1903 and are in direct contradiction in 1915 and 1916, the moving calculations indi-

cating a positive phase while the fixed trend calculations indicate a negative phase.

The points of disagreement are at the beginning of the straight lines used for the fixed trend. The years 1903 and 1904 are at the beginning of the first line, while 1915 and 1916 occupy the same place for the



second line. From the analysis of the weights of the original data in producing the constants m and b, considering the expression $\sum_{i=0}^{i=n}(a_i s_i)$, it was seen that the first half of the original items had less weight than the last half, and that the first few items would have very little weight while items near the end would have correspondingly greater weight. This would make it possible for the fit to produce unreliable results at the beginning. This consideration makes it seem more probable that the moving trend is giving better results during these years, because each ordinate of moving trend is produced by the corresponding item of original data and the items of original data which precede it and not those which follow it. This also means that there is no necessary relation between the residuals from the fixed trend and those from the moving trend.[1]

It seems highly probable that the moving calculations are yielding

[1] There might be some question as to the connection of the moving average to the moving trend. There is no necessary connection because when the ordinate of moving trend has been calculated, half the data for the moving average at the same period has not yet occurred.

the more accurate indications at these disputed points, particularly in 1915 and 1916, because the moving secular trend and the moving integration yield similar results; there is the further difficulty of a straight line trend at the beginning of the fit; and finally we know that 1915 and 1916 were years of considerable business activity which would coincide with the positive phase of the cycle.

Throughout the rest of the curve the moving calculations are in fairly close agreement with the fixed trend calculations as to direction of movement of the cycle, but the amplitudes at times are in some disagreement. From our previous analysis we can be certain that there is usually some element of error in the moving calculations which would affect the amplitudes obtained. Hence it is probable that the positive phases for 1907 and 1920 for Bradstreet's prices have been underemphasized.

In conclusion we can say that judging from the results of our calculations, that we could have used these two methods during the years covered and secured a fairly reliable indication of cyclical changes as they occurred, and as they are now occurring.[1] Neither of these two methods is perfect; both of them, as we have seen, contain elements of error of which we are fully aware.[2] These methods are designed primarily for current calculations in which the fixed trend method is of little or no use, and because of the large amount of tedious computation introduced, they seem inadvisable for historical purposes when some form of the fixed trend is adequate.

BRADSTREET'S INDEX OF PRICES

ORIGINAL DATA

	8.23		8.08		9.07		9.66		20.87
	7.99		7.97		9.04		9.80		20.73
	7.73		8.11		8.82		9.82		18.83
00	7.65	05	8.21	10	8.88	15	10.38	20	15.68
	7.57		8.24		8.77		11.14		12.37
	7.43		8.31		8.46		11.75		10.82
	7.59		8.34		8.66		11.44		11.06
01	7.67	06	8.75	11	8.89	16	12.80	21	11.35
	7.69		9.00		8.96		13.94		11.42
	7.88		8.94		9.27		15.12		11.70
	7.88		8.93		9.16		16.40		12.07
02	8.09	07	8.75	12	9.48	17	17.07	22	13.35
	8.08		8.13		9.46		18.08		13.72
	7.96		7.96		9.14		18.91		13.67
	7.75		7.93		9.01		19.12		12.82
03	7.87	08	8.07	13	9.23	18	18.91	23	13.14
	8.10		8.30		8.86		17.63		13.20
	7.94		8.30		8.62		17.24		12.56
	7.76		8.50		8.71		20.00		
04	8.00	09	8.96	14	8.86	19	19.90		

[1] June, 1924.

[2] The moving integration method might not work so well with a series which has a large seasonal variation due to the failure of the seasonal variation to sufficiently cancel. The writer has, however, used these two methods with other series and has secured results similar to the above, although one of the series so used had a large seasonal content.

FAMILIAL DIFFERENTIAL FECUNDITY

By Hornell Hart, *Bryn Mawr College*

How rapidly are the American people declining in intelligence because of the tendency of families with inferior children to be prolific? This question presents a vital but as yet unsolved problem. In a recent article in the *Scientific Monthly* [1] the writer discussed available data with regard to occupational differential fecundity, and pointed out that the men in the occupations whose members produce the most intelligent children tend to produce also the fewest children, and that this tendency is having a slight but unquestionable depressive effect upon the ability of the rising generation in the United States as measured by mental tests. That study indicated, however, that the important question to be investigated has to do with the effect of differential fecundity as between *families* rather than as between *occupations*. The present article summarizes the results of an attempt to study this latter question in Davenport, Iowa. The problem investigated may be stated in popular terms as follows: How much more intelligent would the children of Davenport have been on the average, if the less intelligent families had had as few children as the intelligent families have?

Through the courteous coöperation of Superintendent Frank L. Smart, and of the principals, teachers, and officers of the Davenport public schools, arrangements were made to give certain tests and to secure certain information relative to a selected group of children, in November and December, 1923. Considerations controlling the selection of the families to be studied were that the group chosen should constitute as representative a sample as possible of the children of the city, and that the families from which they came should be as nearly as possible completed, *i. e.*, families in which no more children were likely subsequently to be born. In order to fulfill the second of these conditions, it was necessary that the children selected should be as old as possible, since older children come, of course, from families longer established and with older parents who are less likely to have additional children. In order to fulfill the condition of being a fair sample, it was necessary to select children of an age below the limit at which complete separation from the school system becomes legal, for elimination from school is a notoriously selective process. Since retardation is also

[1] *Scientific Monthly*, 19 (1924), pp. 527–532.

selective, it was necessary to choose the children on an age rather than a grade basis.

In Davenport, a relatively small fraction of the children leave full-time school before their sixteenth birthday, and of those who do leave the great majority attend part-time school. It was decided, therefore, to confine the study to families containing children who would have their sixteenth birthday in the year 1924, and who, therefore, were born in 1908. Because of the relatively small number of such children in parochial schools, and the relatively great difficulty of reaching them, it was decided to confine the survey to public school children. Practically all children of the type specified were to be found at the date of the survey in the high and intermediate schools, the part-time schools, and the special classes for retardates. Individuals attending regular sixth or lower grades would not be included in the above groups, but very few persons fifteen years old are allowed to remain in the regular grades when so much retarded. The present study was confined, therefore, to families containing children born in 1908 who were attending the Davenport public high, intermediate, part-time, or special schools in November and December, 1923. Of such families 589 were studied, including 596 children born in 1908.

In order to study correlations between characteristics of siblings in these families, and in order to gain additional information relative to the larger families, intelligence tests were given to younger brothers and sisters of the children born in 1908 who were reported as being ten years old or older and who could be reached in the public schools. Mental tests of 300 such children were secured (including a few children under ten for whom Binet quotients were already available).

The fundamental purpose of the investigation was to study in the selected families the relationship between the number of surviving children and the mental-test ability of the children. These two variables are defined in this study as follows.

The term "the number of surviving children in the family" means the number of children in that family born in the year 1908, plus the number of living persons having the same father and mother as the children born in 1908, plus one-half the number of living persons having one parent in common with the children born in 1908 and one different parent. For instance, if the child born in 1908 had two full brothers and one half sister, the size of that family under this definition would be 3.5. Data as to size of family were secured from sheets filled out by the children tested. Where two or more children from the same family were tested, the information blanks were compared, and the final statement as to size of family was arrived at by their joint information.

The mental-test ability of the children was stated in quotients which were derived as follows. Children born in 1908 were given the Army Alpha group intelligence test. Of the younger brothers and sisters, 92 took the Army Alpha test and Form B of the National Intelligence test, while 189 took both Forms A and B of the National Intelligence test. These group tests were all given by Julia Kirkwood, research assistant in psychology, and they were scored under her direction. For 175 children in these families, intelligence quotients based on individual Binet tests made by Catherine Ming Lawrence, director of Special Schools in Davenport, were available. In a large proportion of these latter cases the same individual had been given the Binet test in two or more different years.

The raw scores from all of these intelligence tests were reduced to comparable mental-test quotients by a method such that a quotient of 100 for a child of a given age would represent the average mental-test ability of the Davenport children of that age, while a quotient of 0 would theoretically represent absolute idiocy.

It is interesting to note the correlations between the quotients derived from the various tests used. They were as follows: between Alpha and Form B of the National (92 cases) $.80 \pm .03$; between Alpha and Binet (99 cases) $.83 \pm .02$; between National B and Binet (58 cases) $.46 \pm .07$; and between the two forms of the National (189 cases) $.85 \pm .01$. The difference between the correlations of the Alpha and the National B with the Binet quotients is $.37 \pm .07$, which seems unquestionably to be significant. It suggests that the Alpha test, in spite of its flaws, was a better index of the abilities tested by the Stanford Binet, in the group of children studied, than Form B of the National.

Mental-test ability and size of family, as above defined, were found to be inversely correlated. Table I summarizes the data on this point. It will be noted that the average mental-test quotient is highest in families with one child and descends fairly steadily until it reaches its lowest point in families with twelve children. The probable errors of these averages are calculated on the assumption that each child constitutes an independent item. This is not quite true, however, since the mental-test quotients of siblings are correlated in these families to the extent of $.447 \pm .034$. Especially in the larger families, therefore, the true probable errors are slightly larger than those shown.

The correlation between size of family and mental-test quotients is $-.269 \pm .021$ (or $-.269 \pm .026$ if the number of families instead of the number of children is used for n). The best prediction for the mental-test quotient of children in families with only one living child is 102.7

TABLE I

SIZE OF FAMILY IN RELATION TO MENTAL-TEST ABILITY OF CHILDREN

$r = -.269 \pm .021$

Number of living children in family	Number of families	Children tested born in 1908		Sibs tested		All children tested		
		Number	Average mental test quotient	Number	Average mental test quotient	Number	Average mental test quotient	Regression of m. t. q. on size of family
1	71	71	104.9	0		71	104.9 ± .93	102.7
2	162	163	100.8	47	98.0	210	100.2 ± .54	101.4
3	94	95	104.0	56	98.2	151	101.8 ± .64	100.3
4	102	103	97.8	55	97.4	158	97.7 ± .62	98.7
5	63	62	97.3	43	97.3	105	97.3 ± .76	97.3
6	26	25	95.2	15	98.0	40	96.3 ±1.24	95.9
7	23	23	93.9	25	90.8	49	91.3 ±1.12	94.6
8	23	24	93.3	28	93.4	51	93.3 ±1.09	93.2
9	14	15	97.0	18	96.2	33	96.5 ±1.36	91.8
10	7	7	90.6	7	89.2	14	89.9 ±2.09	90.5
11	3	3	83.7	4	90.7	7	87.7 ±2.95	89.1
12	1	2	79.5	2	92.0	4	85.7 ±3.90	87.8
All sizes	589	593	99.7	300	96.2	893	98.5 ± .27	
δ			12.65 ± .25				12.08 ± .18	

whereas the best prediction in families of twelve children is 87.8. The probable error of estimate is 7.8, indicating that fairly wide individual exceptions occur, *i. e.*, that some stupid children come from small families and some bright children from large families in spite of the general tendency to the contrary.

It is important to know what effect this differential fecundity is having upon the mental-test ability of the rising generation as a whole. Two extreme hypotheses are possible as explanations of the observed correlation. The observed intelligence quotient would arise if either of two hypotheses were true: first, poverty and parental neglect in large families might perhaps affect intelligence adversely through malnutrition, over-crowding, sickness, absence from school, and the like; as an alternative hypothesis if stupid, unskilled, shiftless parents tend to have large families and tend also to beget and rear stupid children a correlation of the sort observed would arise. Under the first hypothesis, the size of the family would be the direct cause of the mental-test ability of the children; under the second hypotheses, the size of the family and the ability of the children would both be results of the qualities of the parents. The first hypothesis involves the supposition that mental-test ability is not at all hereditary, either biologically or socially; the second assumes that it is hereditary either one or both ways.

Whichever of these hypotheses is adopted, it is clear that the mental-test ability of the rising generation would improve if large families were eliminated. Under the hypothesis that the size of the family directly influences the mental ability, if no family had more than five children, this would eliminate 65 of the 199 children with mental-test quotients of less than 90, and it would eliminate only 9 of the 173 children with quotients of 110 or higher; that is, it would take out 33 per cent of the children below normal and only 5 per cent of the children above normal in mental-test ability.

The hypothesis of social and biological transmission of mental-test ability is, however, more consistent with the rest of scientific knowledge. Under this hypothesis, allowing nothing for the direct influence of size of family, we may find what the average mental-test quotient of the children born in 1908 is, and compare this with what the average would have been if all the families had been of the same size, assuming that the average mental-test quotients for families of given fathers and mothers remained the same under the altered size of families. Under this line of reasoning it appears that, if differential fecundity were eliminated, the mental-test ability of the rising generation would be 1.54 points higher than it is (in terms of the quotient used in this study). This difference is .122 of the standard deviation of the mental-test ability of the children born in 1908, who approximate a fair sample of the rising generation of Davenport. Expressed in terms of Army Alpha, this difference amounts to 3.7 points on that scale. The significance of this difference may be seen more clearly by comparing it with the difference between skilled and unskilled men. The following are the official median Alpha scores for men of the occupations named, in the United States army:

Occupation	Cases	Median score
General electrician	499	80.8
Plumber	270	66.2
General machinist	1,251	62.8
General blacksmith	351	61.1
General carpenter	792	59.8
Painter	648	58.7
Bricklayer	207	57.9
Median		61.1
Laborer	1,453	46.7
Difference		14.4

The effect of differential fecundity in Davenport has thus been to reduce the mental-test ability of the rising generation by about one-

fourth of the distance between the ability of typical skilled and typical unskilled workmen.

Familial differential fecundity, as studied in the above investigation, includes all of the effects of occupational differential fecundity as well as the differences between families whose fathers are in the same occupational groups. It will be recalled that in the previous article the amount of depression in mental-test ability assigned to differential occupational fecundity was .6 of one point I. Q. The present investigation of familial differential fecundity shows a depression amounting to 1.5 points in terms of mental-test quotients (which for this purpose are practically identical with intelligence quotients). While the present data with respect to familial differential fecundity cover only a representative sample in the city of Davenport and hence are not as comprehensive as the data available with respect to occupational differential fecundity, the fact that the Davenport study deals with completed families and that it analyzes differences between families rather than merely between occupational groups, makes the results of this later investigation more significant than an occupational analysis could be as an index of the speed with which disgenic tendencies are operating in the cities of the United States.

It is beyond the scope of the present article to discuss certain auxiliary investigations carried out in the study, in which correlations between size of family and school progress, school elimination, the energy of the children, the dependency of the families, and other variables were inquired into. It is sufficient at this point to state that the evidence indicated decidedly that children reared in large families were at a marked disadvantage in all these particulars. Those interested in further details should write to Dr. Bird T. Baldwin, Director of the Iowa Child Welfare Research Station at Iowa City, Iowa.

The conclusion indicated by the Davenport study is that from the standpoint of child welfare, reduction in the size of large families would be a step decidedly beneficial to the welfare of the coming generation.

FORECASTING THE ACREAGE OF COTTON

By Bradford B. Smith, *Associate Statistician, U. S. Bureau of Agricultural Economics*

INTRODUCTION

The economic relation between prices and acreage has been observed by several writers; for example Hubbard [1] states it thus:

> *Acreage and Price.*—The price received for the preceding year's crop is an important factor, since, other things being equal, a high price one year means an increase in acreage the next. The price of food and feed may offset the high price for cotton and prevent any increase in acreage. The planter has learned the wisdom of crop rotation to preserve the fertility of his soil, and he now grows a certain proportion of his supplies at home in any event. But when feed and food are high in price, it may be that he will find it cheaper to raise them than to buy them. In such case the high cotton price will not bring an increase in the cotton acreage. . . .

On the other hand but few successful attempts have been made to establish the numerical or statistical relation between cotton prices, and other factors, and acreage. Professor Moore [2] has pioneered in this field and by usual methods of correlation has secured formulae for forecasting acreage based on correlations ranging from .53 to .64 in value, the correlation secured between percentage price change and subsequent percentage acreage change being .532. Although this coefficient is of sufficient magnitude to verify the existence of an economic-psychological relation between price and subsequent acreage, the forecasting formula derived from it (regression equation) does not give forecasts of sufficient accuracy for most purposes, for the probable error of such forecasts would be 57 per cent of the standard deviation of the acreage figures. The need, then, is for a more intensive analysis, producing formulae of greater accuracy. Such was the aim of the analysis described below, which resulted in several formulae for indices forecasting acreage, the correlation between index and actual being as high as .98 and .99. The indices resulting from two of these formulae (No. 1 and No. 7a) were graphed and the results may be observed on pages 42 and 47.

UNDERLYING THEORY

The economic theory constituting the hypothesis for the subsequent statistical analysis may be briefly predicated as follows:

The producers of agricultural commodities will, when taken in the

[1] W. B. Hubbard, *Cotton and the Cotton Market*, D. Appleton & Co. 1923, p. 20.
[2] H. L. Moore. *Forecasting the Field and the Price of Cotton*, Macmillan, 1917.

mass, plant that product which they believe will yield them the largest net returns, or profits. One of the chief factors influencing the net returns is the selling price of the selected crop relative to the possible crops. Thus if the producer is of the opinion that there will be relatively a high price for his cotton crop—that is, relatively higher than corn, for example—he will desire to plant cotton rather than other crops; and the greater the relative price the more he would wish to have planted. We must therefore examine the factors which influence his opinion of crop profitability at the time decision is reached as to the crop and acreage to be planted. Since prediction of future conditions must be based upon analysis of present conditions, the price of cotton during the planting period might conceivably be a prime factor in the formation of the producer's opinion as to future price and hence of his decision with reference to acreage. We shall therefore see if there is a statistical relation between prices in the period, November to March, and the subsequent acreage of cotton.

The price which should be used is, of course, one which is given wide publicity; and this is logically the wholesale price at one of the large markets, New Orleans or New York. The New Orleans prices probably have less of the "technical" fluctuation in them than the New York prices, since there is probably less of the purely speculative element in them. Producers moreover, might be more familiar with the New Orleans market than the New York, owing to its geographic location. There is, however, little choice between them. Both were used, as shown in the sequel, and by process of trial it was ascertained that the average of the two gave the higher correlation. It might be urged that a future price should be used, but these prices are not so well comprehended at large nor given as wide publicity as the spot market prices. Hence the average spot price of cotton (arbitrarily taken by calendar months) during the late harvesting and early planting period may tentatively be considered to have psychological influence in determining the subsequent acreage of cotton.

In common with most other prices cotton prices underwent marked inflation during the war period. Since there is no reason to think that acreage changes should bear a relation to changes in the value of gold, the proportion of price change due to this factor should be eliminated. This could be accomplished through dividing by a wholesale price index. As pointed out, furthermore, it is presumably the price of cotton, relative to the price of other commodities which might be planted, which influences the planter's decision. Both the elimination of inflation due to change in money value, and the establishing of the cotton quotation relative to other agricultural commodities may be

accomplished through dividing by a wholesale price index of agricultural commodities. We thus secure a relative price to compare with acreage. In this connection there is the possibility that all crop acreage may have a measurable tendency to increase as agricultural prices rise, relative to prices other than agricultural. Should this influence prove marked, it could be handled by taking the price of cotton relative to all agricultural products relative again to prices other than agricultural. This represents, however, a somewhat complicated concept.

Hitherto we have been concerned solely with the factors which might influence the planter's *inclination* to change crop acreage; we must also consider the factors determining his *ability* to expand his acreage to conform to his inclination, since the latter modify the expression of the former. Consider the case of a relatively high spot market price; on assumption, then, the producer would desire to expand his cotton acreage. This, however, requires an investment of increased magnitude. He must either supply the capital from his own resources or secure it in some form of loan. His ability to finance himself—assuming a moderate correlation between income and expenditure in any given year, *i. e.* eliminating to a degree the factor of personal saving over any extended period—is largely reflected by the profitableness of the crop year through which he has just passed. This in turn will be reflected by the value of the crop produced. This value is the product of total production and unit price. If we assume that the demand for cotton approximates a reciprocal relation (*i. e.* increases in prices proportional to decreases in supply), then this value figure from year to year has within it the tendency to be a constant. The value of yield per acre, on the other hand, through eliminating the offsetting variability due to acreage changes forms a measure of the success of the producer's year's enterprise in terms of a unit of one acre. That is, this figure will reflect the profitableness of growing cotton as an industry, irrespective of acreage changes; whereas a large value of total production could conceivably be due to a heavy acreage increase rather than to yield and price increase. Since costs parallel acreage to a degree, it would therefore not necessarily mean a profitable undertaking. On the other hand, a large production means a lowered price, and through that path of influence, has a part in determining the producer's inclination to change acreage in the ensuing year. Should we eliminate this indirect effect there might still remain a residual relation between production and ensuing acreage. We may therefore conclude to use the value of the yield per acre series as a measure of the producer's ability to finance himself, and use the total production as a measure associated

primarily with price, and residually with the country's success in the cotton enterprise.

The producer's ability to secure financial assistance from other than his own resources is to a degree dependent on the opinion of those whose aid he seeks as to the prospects of there being a profitable year in cotton. (This does not consider, of course, "hard times" or general financial condition of the country extraneous to the situation in cotton.) The opinion of those who extend financial assistance is largely determined on the same basis as that of the producer, and hence on prices. Hence an ascertainment of a statistical relation between price and subsequent acreage will bridge this relation.

We have now assembled the factors which, through determining the producer's decision and his ability to carry out that decision, should theoretically enable us to determine in advance the acreage of cotton planted. To determine the quantitative relation existing among these factors and acreage planted we may analyze such relations existing in the past and propound that, general economic relations remaining the same, these same relations may be used to forecast acreage.

Note.—Theoretically the relation should be established with reference to planted rather than harvested acreage, but the variation in abandonment from year to year is insignificant when compared with total aggregate changes; and since the vital figure is the harvested acreage, the prices were related to that figure.

THE SERIES

Symbol	*Description*
N_o	New Orleans average of daily spot quotation in cents per pound during November of year preceding the harvest year to which related, divided by U. S. Bur. of Labor Index of Farm Products' Wholesale Prices; this quotient is multiplied by one thousand (to take out decimals) and from the product is subtracted a similar product for the same month of the preceding year; to the difference so secured is added 100 (to take out negative signs). That is, *No* is the November relative price change over preceding year. Algebraically, letting n_o represent the spot price aveage for November in New Orleans; I_n the Bur. of Labor Farm Prod. Index for November; and additional subscripts the difference in years from the harvest year to which related, $$N_{o-0} = \left\{ \frac{1000\, n_{o-1}}{I_{n-1}} - \frac{1000\, n_{o-2}}{I_{n-2}} + 100 \right\}$$
N_y	Same as N_o, except New York price used.
N	Sum of N_y and N_o.
D_o D_y & D	Same as the November series above, except December prices used.
J_o J_y & J	Same as the November series, except January prices, and price of January in harvest year to which related.

F_o F_y & F . . . . . Same as January series, except February prices used.

M_o M_y & M . . . . Same as January series, except March prices used.

P . . . . . Production in bales divided by 10^5 for the year preceding the harvest year to which related minus production in bales divided by 10^5 for the year preceding the harvest year to which related by two years. To this difference is added 100.

Y . . . . . Average U. S. yield in pounds per acre for year preceding harvest to which related multiplied by average New Orleans spot market price in cents per pound of December of the same year divided by one-tenth of the corresponding Bur. of Labor Index of Farm Prod. From this figure a similar figure for the year preceding the harvest year by two years is subtracted and to the difference is added 100 to take out the negative signs. Algebraically, letting additional subscripts represent the difference in years from harvest year to which related, y yield per acre, d_o the New Orleans spot price in December and I_d the Bur. of Labor Index numbers for December,

$$Y = \frac{10y_{-1}d_{-1}}{I_{d-1}} - \frac{10y_{-2}d_{-2}}{I_{d-2}} + 100$$

A . . . . . A is the dependent variable, acres harvested, and is the number of acres harvested in any given year divided by 10^5 less a similar figure for the preceding year plus 100.

These series are shown in Table I together with the original prices, yields, productions and acreage figures from which derived.

The reasons for using the "first differences" rather than the original values, the method apparent from the definition of the series to be used, are several:

(1) The necessity of computing trends is obviated; each year is then based on the preceding and hence in the future the danger of error accumulating from erroneous trend values is negligible.

(2) In most price data, which are usually intimately associated with the phenomena of diminishing returns (essentially a curvilinear relation), relationships between variables are apt to be non-linear. Such relations are difficult to handle by correlation and multiple correlation methods. The use of first differences tends to transform such non-linear relations into linear.

(3) Since we are dealing with phenomena having their root in psychology, it is rational to suppose that the recent conditions are the most vividly remembered, and consequently it is a change of condition relative to this remembered condition, *i. e.* the previous year, rather than a change of condition relative to some average, which is effective in determining the policy for the new year. This hypothesis was supported by tests, correlation between deviations from trends being markedly lower than correlations of deviations from preceding years.

TABLE Ia

PRICE SERIES USED IN STUDY

Harvest year	Price of cotton at New Orleans, cents per 100 lbs. Average monthly middling spot quotation					Price of cotton at New York, cents per 100 lbs. Average monthly middling spot quotation				
	November preceding year	December preceding year	January	February	March	November preceding year	December preceding year	January	February	March
1901	948	950	952	920	849	989	1,011	1,031	951	861
02	732	793	788	808	854	794	845	827	863	905
03	782	814	866	936	973	845	863	895	965	1,007
04	1,072	1,252	1,406	1,438	1,507	1,123	1,283	1,442	1,487	1,558
05	950	748	683	745	745	1,000	790	716	775	803
06	1,128	1,188	1,156	1,067	1,084	1,144	1,213	1,187	1,113	1,135
07	1,039	1,053	1,046	1,049	1,083	1,076	1,071	1,085	1,103	1,120
08	1,084	1,154	1,184	1,163	1,093	1,102	1,189	1,173	1,153	1,101
09	897	878	934	942	939	940	923	967	982	977
10	1,440	1,496	1,523	1,488	1,474	1,477	1,524	1,487	1,484	1,505
11	1,450	1,485	1,495	1,462	1,454	1,477	1,507	1,490	1,430	1,451
12	935	917	953	1,031	1,065	943	937	955	1,034	1,063
13	1,215	1,281	1,258	1,251	1,245	1,235	1,301	1,307	1,280	1,261
14	1,326	1,298	1,293	1,290	1,295	1,368	1,304	1,271	1,283	1,327
15	743	718	787	801	834	766	753	828	854	901
16	1,150	1,189	1,204	1,145	1,173	1,188	1,232	1,233	1,173	1,189
17	1,945	1,834	1,733	1,714	1,794	1,991	1,829	1,759	1,589	1,846
18	2,808	2,907	3,107	3,092	3,276	2,978	3,074	3,226	3,176	3,374
19	2,975	2,944	2,884	2,697	2,684	2,969	3,022	2,910	2,627	2,774
20	3,958	3,989	4,028	3,940	4,069	3,940	3,919	3,929	3,877	4,120
21	1,765	1,464	1,453	1,285	1,108	1,881	1,568	1,663	1,344	1,174
22	1,727	1,716	1,653	1,636	1,674	1,801	1,830	1,794	1,790	1,832
23	2,534	2,548	2,751	2,878	3,043	2,564	2,565	2,755	2,863	3,055

TABLE Ia

PRODUCTION, YIELD, ACREAGE AND CODED SERIES

Harvested year	Coded series										Preceding years production bales 1,000	Coded series P	U. S. average yield preceding yr. lbs. per acre	Coded series Y	U. S. harvested acreage $+10^6$	Coded series A
	N_o	N_y	D_o	D_y	J_o	J_y	F_o	F_y	M_o	M_y						
1901															268	
02	63	67	64	62	63	58	71	74	87	91					272	104
03	103	102	104	104	113	112	119	115	116	115					271	99
04	156	156	174	172	175	176	162	164	167	169					312	141
05	63	61	17	18	0	0	11	9	4	4					271	59
06	132	128	162	159	170	170	150	153	153	154	10,575		187		314	143
07	78	81	72	71	73	74	81	81	82	79	13,274	127	203	69	297	83
08	104	101	113	116	118	111	120	112	103	99	11,107	78	179	91	324	127
09	72	75	60	61	59	65	61	68	67	70	13,242	121	195	46	309	85
10	135	133	139	135	139	131	130	124	133	132	10,005	68	154	115	324	115
11	113	113	116	117	111	114	119	115	120	116	11,609	116	171	153	360	136
12	32	30	27	26	31	32	40	44	44	44	15,693	141	208	8	343	83
13	136	137	145	145	136	141	129	131	128	131	13,703	80	191	171	371	128
14	102	104	91	90	97	91	97	94	100	101	14,156	104	182	71	368	97
15	44	42	45	48	51	56	51	57	53	57	16,135	120	209	19	314	46
16	137	139	142	142	133	132	128	126	126	120	11,192	51	170	144	350	136
17	122	122	113	108	105	104	105	94	102	104	11,450	103	157	106	338	88
18	100	104	114	124	133	137	138	149	147	149	11,302	99	160	126	360	122
19	101	92	90	84	82	77	78	71	65	64	12,041	107	161	84	336	76
20	134	134	135	129	134	129	141	141	152	150	11,421	94	162	159	359	123
21	35	43	31	41	39	57	31	39	15	18	13,440	120	178	4	305	46
22	141	140	147	150	134	131	128	136	142	149	7,954	45	125	108	337	132
23	134	130	133	124	156	146	177	164	184	173	9,964	120	142	171	376*	139

*Preliminary figure.

ANALYSIS

The first analysis was confined to prices. Variables N_o & N_y and A were graphed together on one chart with abscissae representing years, T. Similar charts were constructed for $D_o D_y$ & A; $J_o J_y$ & A; $M_o M_y$ & A; $F_o F_y$ & F. A study of these graphs revealed the following:

(1) There is practically no difference between the New Orleans and New York price series. In only one case (January, 1920) out of the entire five sets of series do the changes from one year to the next in New Orleans and New York price series fail to coincide in direction. The two price series move more closely together than does the acreage figure with either price series. Since neither series seems superior to the other, and yet both reveal unusual correspondence to the acreage, both may be used—that is, the average of the two (or their sum) will be used. In further discussion, therefore, reference to any month's price series may be taken to refer to the sum of the New Orleans and New York series.

(2) With the exception of the November series the fluctuations in price series prior to 1907 are considerably greater in proportion to the acreage series than subsequently. That is, there apparently is a different ratio relationship prior to 1907 than subsequently. In the latter period, on the other hand, the ratio between acreage and price series seems to be fairly constant. To determine the ratio relationship for the entire period would be to secure, then, a relationship which was a mixture of two apparently different conditions and conforming strictly to neither. It is probable that sufficient increased accuracy could be secured by treating the two periods separately to offset the probability of error arising from using a smaller number of items. Since we seek relationships now existing the period considered henceforth will accordingly be from 1907 to 1923, until subsequently still further shortened.

(3) If the acreage figure is below the price for one month a similar condition prevails for the other months in the related year. This is particularly noticeable for the acreage of 1912, the price values ranging from 39 to 57 points below. The uniformity of difference for all months in any given year means that the explanation of these residual differences must be sought outside of these price data.

(4) Some rough numerical estimate of the closeness of agreement, or rather the extent of disagreement between the acreage and each month's price series, is desirable as a preliminary to subsequent more precise correlation analysis. Two methods of ascertaining this disagreement were undertaken:

(a) The number of years in which the acreage and price curves moved in opposite direction were counted.

(b) The root mean squares of the differences between acreage and price (average of New Orleans and New York) were secured. This was likewise secured omitting 1912, where the difference is very large, since slight changes in such a large item might in themselves account for the differences between the standard deviations. The results of these rough tests are shown below.

Given month's price series	Number years disagreement in direction	Root-mean-square of differences	
		Period	Without 1912
November	4	8.7	6.4
December	2	9.6	7.3
January	1	8.7	6.1
February	1	8.0	6.7
March	1	9.9	9.2

Inspection of the above table shows that January and February probably have the closer relation to acreage, since the root-mean-squared differences are appreciably less than for other months except in the case of November. In the November series, however, there were four disagreements of direction of change in the curve with reference to the acreage curve changes.

(5) There is, finally, one other condition that may be observed from such charts. In the earlier years the acreage figures tend to be slightly higher than the price, while in the latter years the reverse tends to be the case. This indicates that despite the use of first differences the influence of the passage of time, or the trends of the two series, should be provided for in subsequent mathematical analysis. This was done, but the influence of time—net correlation—was so small that in further analyses it was omitted.

We are now in position to sum the results of preliminary analysis of the graphs.

(1) The average or the sums (N, D, J, and F) of the New York and New Orleans relative price differences should be used.

(2) Years prior to 1907 should be discarded.

(3) Probably no complete determination of acreage can be secured without bringing in factors other than price.

(4) The more accurate forecasts can probably be secured from January and February prices, but prices as early as November can be used to secure some estimates.

(5) Time should be considered as an influencing factor.

We may now proceed to determine the statistical relationship, between the price series (and time) and the acreage series. That is, writing

$$A=K+f_1(N)+f_2(D)+f_3(J)+f_4(F)+f_5(M)+f_6(T)$$

K being a constant to be determined and T representing time with values 07 to 23, our problem is to determine the respective functions.

A series of dot or correlation charts in which the ordinates were the values of A and the abscissae the values of the respective independents showed, insofar as observable from inspection, that the gross relationships were almost perfectly linear, indicating therefore that the functions are of the form wx where w is constant. We will therefore proceed on that assumption with the understanding that, should the relationships subsequently appear to be non-linear when the *residuals* (differences between the observed values of acreage and values estimated by applying the equation to observed values of the independents) are plotted against the independent variables, the functions shall accordingly be modified.

We may then, write,

$$A=K+w_1N+w_2D+w_3J+w_4F+w_5M+w_6T$$

in which w are weights by which the values of the independents must be multiplied in order that an index A' of A may be secured.

Since we have 17 observations (years) and 6 unknowns, a rigid solution for w is impossible. By the methods of least squares, however, we may secure the most probable values of w. When these values are determined and the values of A' secured by applying the equation to each observation in turn, there will be differences between the values of A and A'. If we wish to know how accurate an index we have secured we may measure the agreement of A and A' by securing the coefficient of correlation, R.[1]

Performing these operations gives the following:

$$A'=44.7-.3084N+1.2698D-1.9116J+$$
$$2.1328F-.5024M-.7206T \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

R_1(Correlation from use of equation 1) is .9502.

[1] This coefficient is identical with the coefficient of multiple correlation, *i. e.* in terminology of Yule, $R=R_{A.NDJFMT}$

A value of R, modified for the number of variables used [1] giving a better estimate of probable economic as distinguished from purely mathematical relationship is

$$\overline{R}_1 = .9225$$

Computing the probable error of estimates, $E = .6745\sqrt{1-\overline{R}^2}$, we secure a figure 7.743×10^5 acres. Expressing this probable error as a percentage of the present acreage, $(7.743 \times 10^7)/(4 \times 10^7) = 1.966$, we secure the percentage limits within which it is an even wager that the index will forecast the future. The probability of forecasts being within 3 percent of the true acreage is .70.

The probable error of R_1 is $\pm .024$; and of $\overline{R}$, is $\pm .027$.

An index, A', made by applying the weights and constant secured is shown on the Graph I and compared with the original A series.

This formula (1) is constructed from several variables. The question naturally arises as to which variable is of the most significance in determining the final acreage.

The size of the weights, w or "net regression coefficients" in correlation terminology, gives some idea, assuming about equal standard deviations throughout and also considering the degree of correlation between the independents and the dependent as a measure of the effectiveness of the deviation. Coefficients of determination (d) representing the portion of the squared variability in the dependent attributable

[1] To modify R for the number of variables, we take the formula for error (e) used in least square theory, which includes the number of independent variables, m, in its expression. (See Merriman, Method of Least Squares.) That is, Z being a residual,

$$e^2 = \frac{\Sigma Z^2}{n-m} \quad \ldots\ldots (1)$$

But the following formula is familiar in correlation

$$e^2 = \sigma x^2(1-R^2) \quad \ldots\ldots (2)$$

Whence ΣZ^2 may be written

$$\Sigma Z^2 = n\sigma x^2(1-R^2) \quad \ldots\ldots (3)$$

Substituting this value for ΣZ^2 in (1)

$$e^2 = \frac{n\sigma x^2(1-R^2)}{n-m}$$

or

$$e = \sigma x\sqrt{\frac{1-R^2}{1-\frac{m}{n}}} \quad \ldots\ldots (4)$$

or a modified standard error which may be written, $\overline{E}$. Substituting $\overline{E}$ for e in the formula easily derived in correlation theory,

$$R = \sqrt{1-e^2/\sigma x^2}$$

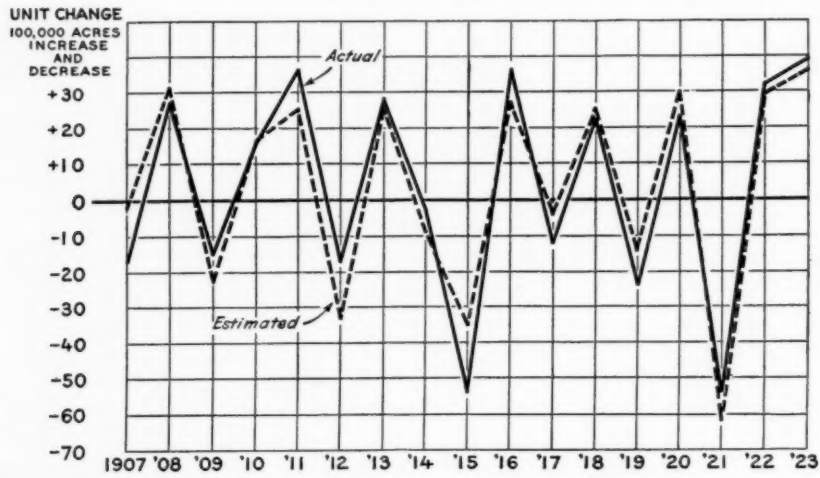
we have

$$\overline{R}^2 = 1 - \frac{1-R^2}{1-m/n} \quad \ldots\ldots (5)$$

or a modified value of the coefficient of multiple correlation: that is, $\overline{R}$ may be regarded as R corrected for the probability of correlation attributable to pure accident of numbers, as in the case of the perfect correlation which would appear to exist when m equals n, which is, nevertheless, quite worthless as a measure of dependence for forecasting purposes. Such a correction is of course needless when n is large, or when but simple as distinguished from multiple correlation is employed.

I

COTTON ACREAGE CHANGES FROM PRECEDING YEARS
ACTUAL CHANGES AND ESTIMATED CHANGES BASED ON FORMULA I
UNITED STATES, 1907–1923



to each independent in any given system, constructed on these two premises may be derived.[1]

[1] A coefficient of determination measuring the contribution of each independent variable to the dependent may be derived as follows:

In the terminology of Tolley and Ezekiel ("A Method of Handling Multiple Correlation Problems," JOURNAL AMERICAN STATISTICAL ASSOCIATION, Dec., 1923) z being an estimated x,

$$R^2_{1.234\ \ldots\ n} = \frac{\sigma_z^2}{\sigma_1^2}$$

But
$$\frac{S(z^2)}{N} = \sigma_z^2 = \frac{S(b_{12.3}\ \ldots\ nX_2 + b_{13.24}\ \ldots\ nX_3 + \ \ldots\ )^2}{N}$$

$$= + b_{12.34}\ \ldots\ n(b_{12.34}\ \ldots\ n\sigma_2^2 + b_{13.24}\ \ldots\ nP_{23} + \ \ldots$$
$$+ b_{13.24}\ \ldots\ n(b_{12.34}\ \ldots\ nP_{23} + b_{13.24}\ \ldots\ n\sigma_3^2 + \ \ldots$$
$$+ \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

or in words, the standard deviation of Z is the sum of the values of each normal equation used for determing the net regression values by methods of least squares times the net regression value of the diagonal variable. But the value of each normal equation is also, by original definition equal to the value of the absolute term, the product moment of its diagonal term and the dependent. Hence

$$\sigma_z^2 = b_{12.3}\ \ldots\ nP_{12} + b_{13.24}\ \ldots\ n\ P_{13} + \ \ldots$$

or

$$R^2_{1.23\ \ldots\ n} = b_{12.3}\ \ldots\ n\ P_{12}/\sigma_1^2 + b_{13.24}\ \ldots\ nP_{13}/\sigma_1^2 + \ \ldots$$

If now we express the deviations in the original variables in terms of their standard deviations, the new regression $b^1_{12.34}\ \ldots\ n$ and similar terms become $(\sigma_2/\sigma_1)b_{12.3}\ \ldots\ n$ and similar terms.
Likewise P_{12} becomes $P_{12}/\sigma_1\sigma_2$ or r_{12}; σ_1^2 becomes unity, and $R^2_{1.234\ \ldots\ n}$ becomes σ_z^2.

Thus $\sigma_z^2 = b^1_{12.3}\ \ldots\ n\ r_{12} + b^1_{13.24}\ \ldots\ n\ r_{13} + \ \ldots$

The term $d_{12.3\ \ldots\ n} = b^1_{12.3\ \ldots\ n}\ r_{12} = b_{12.3\ \ldots\ n}\ P_{12}/\sigma_1^2$

may then be considered as the proportion of squared deviation in the dependent due to variable X_2 as compared with the total squared deviation in the dependent, and hence may be considered as a "coefficient of determination." This is Dr. Sewall Wright's coefficient of determination when applied to the special case of multiple correlation; derived, however, directly from the least square treatment of correlation and without joint terms. See "Correlation and Causation" *Journal of Agricultural Research*, January, 1921.

A second measure of the individual importance of the several price series in determining the acreage may be had by securing the coefficients of partial correlation[1] existing between the dependent and each of the independents. These measures together with the gross and intercorrelations are tabulated below.

TABLE II

Variable	Correlated with					Determination of *A*	Partial Correlation with *A*
	D	*J*	*F*	*M*	*A*		
N	.9763	.9373	.8908	.8781	.8299	—.304	.506
D		.9709	.9217	.8972	.8707	1.435	.624
J			.9773	.9489	.8768	—2.034	.605
F				.9855	.9007	2.445	.665
M					.8810	—.631	.030

An examination of the above tabulation (Table II) indicates that the three series *D*, *J*, & *F* are the most important in determining *A*. The series, *M*, shows such small determination and partial correlation that we may conclude to eliminate it in further analysis.

The multiple correlation being only about .95 there is evidently (1) some change in acreage which is not traceable to prices or (2) we have insufficiently expressed the relationship between prices and acreage. By a method designed by Mr. Ezekiel[2] we may ascertain if the original assumption of linear relations is erroneous and if so, ascertain the nature of the curvilinear relationship.

The charts called for in such analysis, wherein the residuals are plotted as ordinate deviations from the net regression lines against the independents, were accordingly made. They reveal a striking absence of curvilinear relationship, the residuals being scattered around the net regression lines in as nearly a random manner as could be conceived. When the residuals were plotted against time, however, it was distinctly observable that the scatter in the later years was much less than the scatter during the earlier years. This could be due to the

[1] For a description of partial coefficients of correlation, see G. Udney Yule, *Introduction to the Theory of Statistics*.

[2] "A Method of Handling Curvilinear Correlation of Any Number of Variables;" Mordecai Ezekiel; JOURNAL AMERICAN STATISTICAL ASSOCIATION, Dec., 1924. The method may be briefly summarized as follows: The usual coefficients of net regression are secured, and values secured from the regression equation subtracted from the related values of the dependent, giving residuals. The net regression lines are graphed, with abscissae the several independents. Then the residuals are graphed as ordinate deviations from the net regression line with abscissae the associated values of the several independents. The net regression lines are then curved to pass through these plotted residuals, and the curves so derived used to describe the functional relations between independents and dependent in securing a new set of residuals. The new residuals are treated as were the first, and so on, until the approximation process will no longer reduce the sum of the residuals squared.

first mentioned cause of residuals, *i. e.* the influence of some other factors or, it may be due to a different relationship existing between prices and acreages during the earlier years. The latter hypothesis is supported by an examination of the trend of the United States Acreage of Cotton which shows a distinct break in 1911, or thereabouts.

To test the proposition of the effect of other factors, the following was written:

$$A = K + w_1P + w_2Y + w_3(D_o + J_o), + w_4F_o$$

A solution for the values of w will then give a forecasting or estimating formula which includes production and yield-value series as well as the three more important price series. D_o was added to J_o to reduce the number of variables, since a large number complicates both the solution and the interpretation.

The solution gives the following formula:

$$A' = 185.270 - .9151P + .5318Y - .8767(D_o + J_o) + 1.3152F_o \quad \ldots\ldots\ldots (2)$$

The correlation between A and A' (estimates) was

$$R_2 = .9304 \pm .0220$$
$$\overline{R}_2 = .9190 \pm .0254$$

or appreciably lower than the correlation secured from the pure price series.

The gross and intercorrelations are tabulated below with the coefficients of determination.

TABLE III

Variables	Correlated with				Determination
	Y	(D_o+J_o)	F_o	A	
P	−.500	−.733	−.549	−.588	+.474
Y		+.923	+.931	+.869	+.831
(D_o+J_o)			+.951	+.876	−1.993
F_o				+.896	+1.554

Examination of the coefficients of determination indicates that the price series are more important than the production and yield-value, indicating that prices have more to do with determining the producers' mind with reference to acreage, than do production and yield-value, though a portion of the effect of the latter may be considered as included in the prices, since high correlation exists between them (See Table III above).

As the introduction of the additional factors failed to increase the

accuracy of the estimates, we may decide then to shorten the period over which the relationship is established for reasons cited previously. Accordingly the period 1913 to 1923 inclusive is taken. Writing

$$A = K + w_1 D + w_2 J + w_3 F$$

and solving, gives

$$A' = .007 + 1069D + .3615J + .0048F \quad \ldots\ldots\ldots\ldots (3)$$

$$R_3 = .9854 \pm .0079$$

$$_{R_3} = .9729 \pm .0109$$

The tabulation of coefficients follows:

TABLE IV

Variable	Correlated with			Determination	Partial correlation
	J	*F*	*A*		
D	.954	.892	.956	.228	.815
J		.984	.984	.732	.297
F			.954	.011	.009

The considerably increased correlation, indicating more uniform agreement throughout the shorter period, may be given economic explanation along these lines:

(1) The Boll weevil had covered practically all of the cotton belt, and was no longer such an unknown factor to the grower.

(2) Production with the exodus of colored labor, was put on a more commercial basis and hence acreage would show a more uniform response to price.

(3) Acreage expansion into new land as pointed out above had about reached its peak value and the acreage curve had levelled out. New expansion is at the expense of other products.

Examination of Table IV indicates that the February price is of practically no importance in this latter period. And hence, in the sequel that series is dropped.

On the hypothesis that a slightly curved relation might better define the effect of price on acreage,

$$A = K + w_1 J + w_2 J^2$$

was written. Solving gave

$$A' = 035.69 + .8822J - .1030J^2 \quad \ldots\ldots\ldots\ldots\ldots (4)$$

$$R_4 = .9841$$

Since r_{AJ} is .9840, the increase to R_4=.9841is insignificant. Experiments with third order parabolae also gave fruitless results.

Writing now again an equation including other than price series,

$$A=K+w_1P+w_2Y+w_3D+w_4J$$

we obtain the following:

$$A'=50.802-.3640P+.0609Y-.1805D+.5460J \quad \ldots\ldots (5)$$

$$R_5=.9909 \qquad \pm.0037$$

$$R_4=.9875 \qquad \pm.0051$$

In order to secure a formula which may be used earlier than the January figures permit, the above formula (5) was solved with the omission of J, *i. e.*

$$A'=8.210+.0482P+.1210Y+3592D \quad \ldots\ldots (6)$$

$$R=.9622$$

In order to reduce the number of independent variables as much as possible the best price series, J, and the production series, P, were used. That is, writing

$$A=K+w_1J+w_2P$$

the solution gives

$$A'=-9.107+.4476J+.1520P \quad \ldots\ldots (7)$$

$$R=.9885 \qquad \pm.0047$$

$$\overline{R}=.9859 \qquad \pm.0057$$

This is the formula which is recommended, though in making a forecast it would be advisable to use several formulae and compare the results given, and thus make selection.

In using these formulae it is more convenient for the statistician's analysis of relationships and selection of a formula which in his judgment best fits the year under discussion to use the derived series, as they have been in this paper, such as D, J, P etc., than to use the original series; it is not difficult, however, to write the formulae in terms of the original series. For example formula (7) may be so written as follows in terms of the symbols defining the series given on page 34 and letting A now mean the actual harvested acres, and P the production in bales of year related to harvest by subscript designation,

$$\frac{A'_o-A_{-1}}{10^5}+100=-9.107+.4476\left[\frac{(j_{o-o}+j_{y-o})1000}{I_{j-o}}\right.$$

$$\left.-\frac{(j_{o-1}+j_{y-1})1000}{Ij_{-1}}+200\right]+.1520\left[\frac{P_{-1}-P_{-2}}{10^5}+100\right]$$

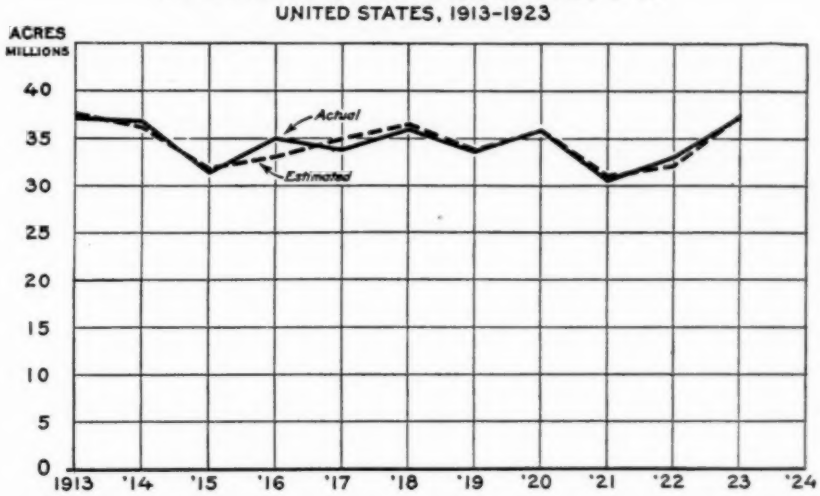
or

$$A'_o = A_{-1} + 44{,}760{,}000\left(\frac{j_{o-o}+j_{v-o}}{I_{j-o}} - \frac{j_{o-1}+j_{v-1}}{I_{j-1}}\right) + .1520(P_{-1}-P_{-2}) - 438{,}700 \quad \ldots\ldots (7a)$$

This index is shown in the following graph.

II

COTTON ACREAGE HARVESTED AND ACREAGE ESTIMATED FROM FORMULA 7-A
UNITED STATES, 1913-1923



NOTE: In preparing this graph the revised acreage figures for 1922 and 1923, as recently published in the 1923 Yearbook of the Department of Agriculture were used, rather than the preliminary figures given in Table I. The revised figures were not available when the study was commenced.

PROGRESSIVE VARIATION IN SEASONALITY

By W. L. Crum

I. THE PROBLEM

The empirical determination of the seasonal movements in the time series of economic statistics is, as a process, scarcely in substantially final form, and indeed has not yet passed from the stage in which methods are the subject of controversy. There has been sufficient progress, however, to yield a fairly accurate picture of the seasonal swing in a large number of important economic factors. The attempt is already being made to proceed from the indexes of seasonal variation thus determined to the causes from which, in a particular case, the variation presumably arises.[1]

As may generally be said of economic fluctuation, seasonal variation arises from a complex of causes which may be grouped roughly as external and internal. The external causes are those natural, and largely inevitable, phenomena and those non-economic artificial conditions which together may be looked upon as furnishing the impulses from which economic seasonality ultimately flows. The internal causes are those artificial conditions in the economic structure which markedly modify the response of economic factors to the ultimate external causes, but which are probably incapable of initiating seasonal variation.

The inquiry into the nature and identity of the causes of seasonal variation does not advance far before the question of permanence arises. In so far as we find greater evidence of a natural invariability of the causal complex from which seasonality develops our outlook upon the problem must become the more fatalistic. From this point of view the above classification of causes into active external and passive internal assumes importance. In the main the external causes are not artificial but natural; and, although science may extend somewhat our control of natural forces, the portion of the totality of such forces which we may hope ever to control effectively is small indeed. For all practical purposes of the human generations living at any one time the vast forces of nature may be assumed invariable and irresistible. Irre-

[1] The word "cause," in this discussion, is not used in the uncritical colloquial sense, and yet is assumed to signify a more positive relation than the mere concurrence or sequence of events. For the purposes of this article it does not appear necessary to examine the logical implications of this use of the term, but the point is raised as probably bearing upon any general theoretical considerations which may follow from the conclusions of this study.

sistible in their totality, indeed; but subject to slight postponement in their effect or to transfer of their incidence: such postponement and transfer constitute the rôle of the internal causes.

The internal causes are mainly artificial; and, although scarcely capable of rapid adjustment according to our improving knowledge of our needs, nor yet subject to frequent experimentation with a view to determining their most effective form by trial and error, these causes are to a large extent within our control.

The theoretical question is now obvious: can we regulate the internal causes in such manner as to reduce the effects of those external causes which are largely beyond our control? This question applies to all types of economic fluctuation—trend, seasonality, cycles, and irregularities—and is of large practical import in each case. Because, however, of the peculiarly regular form of the seasonal variation, it is by an empirical study of that type of economic fluctuation that we may most confidently expect to reach some conclusion.

Moreover, even if the theoretical inquiry did not point to this empirical test of seasonality, the empirical problem itself would lead to the same investigation. Prolonged study and searching criticism of the actual methods used in measuring seasonal variation cannot fail to raise the question of the permanence of the magnitude being measured. The very process of measurement, when used with care and insight, suggests that seasonality is variable. From the technical side therefore, as well as the theoretical, appears the need for an examination into the variability of seasonal movement.

The objects of the following sections are to describe methods for measuring this variability, to show the nature and extent of the variability in certain instances, and to indicate the manner in which variable seasonality may be eliminated from a series.

II. THE METHODS OF ANALYSIS [1]

Changes in a seasonal index, from one time to another, may take place abruptly and discontinuously or gradually and progressively. The investigator must always be on the watch for the first type of change; for, although changes of this sort are relatively infrequent, they may have very marked effects. As instances of this type may be

[1] These methods were worked out by the author and applied to the interest rate problem in the spring of 1923 at which time a preliminary report of the findings was prepared for Professor W. M. Persons. The methods have been developed independently, however, by other investigators, as follows: Mr. E. C. Snow, on page 334 of the May, 1923, *Journal of the Royal Statistical Society*, used a method analogous to the monthly mean device described herein; and Mr. Harold Flynn developed a scheme analogous to the link relative device described herein, and his procedure is presented on page 104 of *The Problem of Business Forecasting* published by the Pollak Foundation in 1924.

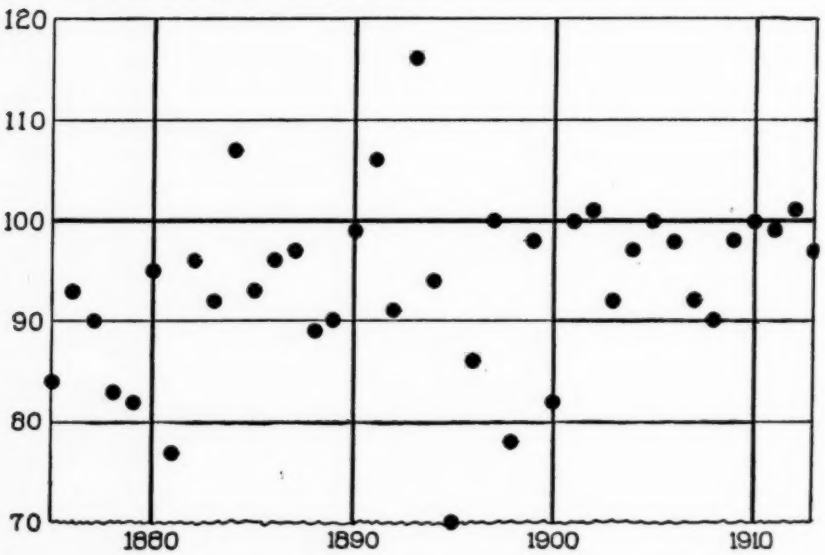
mentioned the changes due to the establishment of a new banking system, or to the opening of a great canal.

It is, however, changes of the second type which are the subject of the present study. The detection and measurement of such changes constitute essentially a problem in secular trend. The methods of analysis must be such that they will reveal the existence and measure the amount of any secular trend present in the seasonal indexes. The obvious procedure is to supplement the usual determination of seasonal indexes by an examination of the trend in those indexes.

If the median-link-relative method of determining seasonal indexes is used, as is ordinarily desirable, the necessary modification in method appears to be the following. Instead of accepting some average of all the link relatives of a particular month (say May) on the preceding month (April) as the *constant* typical relation of the one month to the preceding, the plan involves taking a *variable* typical relation equal to the ordinate of trend for the entire series of particular (*i. e.*, May/April) link relatives.

For example, Chart I shows the May/April link relatives for the

CHART I. MAY/APRIL LINK RELATIVES FOR COMMERCIAL PAPER RATES.



interest rate on 60–90 day commercial paper in New York, 1875–1913.[1] The usual determination of seasonal variation would derive a *single* set of indexes for this entire interval of 39 years; and the type move-

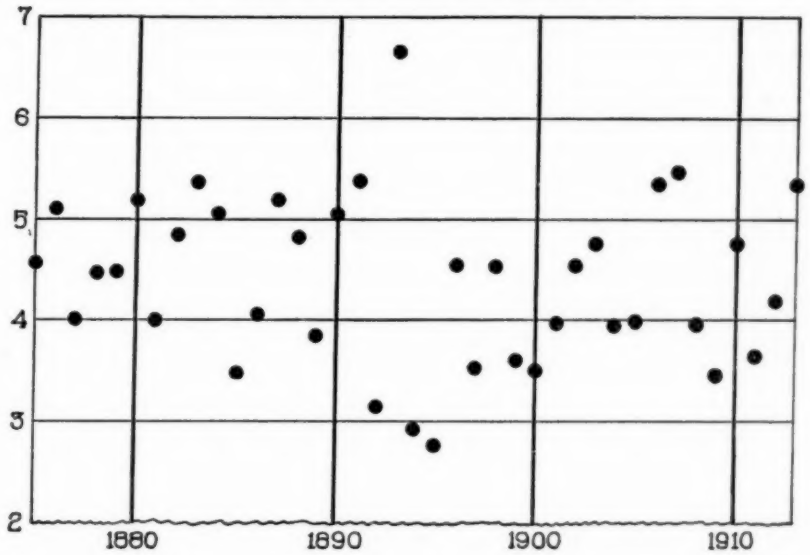
[1] Data on which these link relatives are based appear in *Review of Economic Statistics*, Prel. Vol. V, p. 28.

ment April-to-May used in that derivation would be the median, 95, of the 39 link relatives. For the present purpose, on the other hand, the seasonal index is not fixed and no single type movement April-to-May is assumed. The movement April-to-May at any particular time in the interval 1875–1913 is the ordinate, for that time, of the secular trend fitted to the 39 link relatives. According to this plan an ordinate of trend, for each of the twelve months of the year, is found at the particular time for which the index is desired; and the index is derived from these 12 "typical" link relatives by the usual process of adjustment.[1]

If the method of monthly means is followed in determining seasonal indexes, an obvious corresponding modification in method is used. Instead of taking the arithmetic average of all the values of the given economic variable for the particular month (say May) as the single seasonal type for that month, the type is assumed to be variable and to equal the ordinate of secular trend of all the values for that month (May).

Thus, Chart II shows the above-mentioned interest rate for May of

CHART II. MAY COMMERCIAL PAPER RATES.



each year 1875–1913. The usual determination of seasonal variation by this method would take the average, 93.6, of the 39 values as the single type for May; and the seasonal movement for the entire year would be based upon this and 11 other monthly types. For the pres-

[1] This process is described by Professor Persons in *Review of Economic Statistics*, Prel. Vol. I, p. 31.

ent purpose, however, the May type at any particular time in the interval 1875–1913 is the ordinate, for that time, of the secular trend of the 39 May interest rates.

A striking difference in the formal aspects of the two treatments appears from comparison of Charts I and II. In the one case the trend is upward, in the other downward. Is it possible, then, for the trends for a single month according to the two different methods to be different, and even contradictory, in direction as in this instance? It is reasonable that differences should occur, and indeed it would be surprising if there were no difference. The link-relative scheme compares an individual month with the preceding; and the resulting adjusted index, for any one month, depends cumulatively upon the typical link relatives of all 12 months in the year. The monthly-mean device leads to an independent type for each month of the year. Hence the two trends, for any one month, may be quite different.

On the other hand, the resulting final indexes of seasonal variation (based upon the ordinates of trend) should not differ greatly, for any one time in the interval studied. Differences will exist, due chiefly to two facts. First, neither method yields a perfect measure of seasonal variation, and it is unlikely that two imperfect measures of the same magnitude will be identical. Second, there is an inherent difference in the methods: 12 groups of link relatives, each having an exactly rectilinear trend, do not yield adjusted seasonal indexes which have exactly rectilinear trends. This is illustrated in Table I, in which rather extreme assumptions are made to bring out the significant

TABLE I

COMPARISON OF RECTILINEAR TRENDS IN LINK RELATIVES AND ACTUAL INDEXES. (INDEXES BASED UPON LINK RELATIVES, EXCEPT THOSE IN PARENTHESES, WHICH ARE DERIVED BY ASSUMING LINEAR TRENDS IN THE ACTUAL INDEXES)

	Beginning of the interval		Middle of the interval			End of the interval	
	Link relative	Index	Link relative	Index based upon		Link relative	Index
				links	actual		
Jan.	100	104	100	103	(98)	100	92
Feb.	100	104	100	99	(98)	100	92
Mar.	100	104	100	96	(98)	100	92
Apr.	100	104	100	92	(98)	100	92
May	100	104	100	89	(98)	100	92
June	100	104	100	86	(98)	100	92
July	100	104	100	82	(98)	100	92
Aug.	50	52	125	99	(118)	200	185
Sept.	200	104	125	120	(98)	50	92
Oct.	100	104	100	115	(98)	100	92
Nov.	100	104	100	111	(98)	100	92
Dec.	100	104	100	107	(98)	100	92

point. The link relatives, for each month, have rectilinear trends (all horizontal, except August and September). The adjusted indexes obviously do not have such trends: the indexes at the middle of the interval should be as given in parentheses to meet that requirement. The differences between the computed indexes and those in parentheses are so great that we may waive questions, to be discussed later (in Section VI), of errors arising from the incorrect "centering" of the ordinates, in the year. Suffice it here to observe that straight line trends in the link relatives do not reflect straight line trends in the actual indexes of seasonal variation. For the method of monthly means, however, it is obvious that rectilinear trends in the actual indexes accompany rectilinear trends in the original data. This difference between the two methods is generally not large, but its practical implications are evident.

Further points involved in the selection of method can best be discussed during or after the presentation of specific illustrations in the succeeding sections. Chief among these points are: the comparative reliability of the link-relative and monthly-mean results, the choice between rectilinear and curvilinear trends, the reduction of the influence of irregular items on the results, and the question of where to "center" the seasonal index for a given month or year.

III. COMMERCIAL PAPER RATES

One of the fundamental series of economic data, available over a long interval and subject to marked seasonal variation, is the interest rate on 60–90 day commercial paper in New York. For the purpose of this study the interval was limited to 1875–1913. Earlier years were eliminated because of the seriously disturbed period which culminated in the Panic of 1873, and the effects of which probably persisted into 1874. Later years were omitted because the establishment of the federal reserve system abruptly changed the entire seasonal movement in money rates.

Twelve charts of the link relatives for the several months, similar to Chart I, were constructed and examined. Charts for certain of the months showed a marked drift in the link relatives with passing years, whereas links for other months apparently had no trend. It should be remarked that in no case was the "goodness of fit" high: the scatter from the general trend was quite marked. (The fit for May, shown in Chart I, was among the best of the 12 monthly distributions). Moreover, there were some instances in which the trend appeared to be a parabolic curve rather than a straight line. Both of these comments will be discussed more fully below (Section VII).

Lines of secular trend were fitted to the 12 monthly series of link relatives by the method of least squares. The results, for the *central value* and the *annual increment*, are given in columns 1 and 2 of Table II. The central value, for any one month, applies to the middle

TABLE II

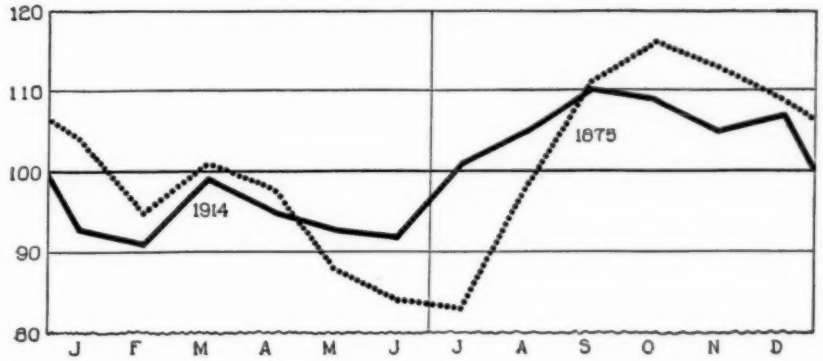
COMMERCIAL PAPER RATES. TERMINAL INDEXES OF SEASONAL VARIATION, LINK-RELATIVE METHOD

	Link relatives				Adjusted indexes for January 1	
	Central value	Annual increment	Ordinate for Jan. 1			
			1875	1914	1875	1914
Jan.	91.5	—.198	95.3	87.5	104	93
Feb.	94.7	.157	91.7	97.8	95	91
Mar.	107.6	.055	106.5	108.7	101	99
Apr.	98.0	—.044	98.8	97.1	98	95
May	93.6	.219	89.4	97.9	88	93
June	97.3	.086	95.6	99.0	84	92
July	104.9	.303	99.0	110.8	83	101
Aug.	111.6	—.394	119.3	104.0	98	105
Sept.	109.1	—.212	113.3	105.0	111	110
Oct.	102.6	—.137	105.3	100.0	116	109
Nov.	97.0	—.018	97.4	96.7	113	105
Dec.	100.1	.124	97.6	102.5	109	107

of that month in the middle year (1894). With this in mind, and by use of the given annual increment, it is possible to compute the ordinates of trend for January 1, 1875, and January 1, 1914, in each of the 12 cases. The results appear in columns 3 and 4 of Table II. Column 3 shows the 12 "typical" link relatives which describe the seasonal movement at that particular time (January 1, 1875). By the usual process of adjustment, these typical link relatives yield the indexes given in column 5 of Table II. Column 6 comes in like manner from column 4.

The differences between columns 5 and 6 of Table II reflect the results of the progressive changes in interest rate seasonality over the 39 years examined. The comparison is assisted by Chart III. It appears from these curves that the principal changes comprise: a marked shrinking of the amplitude of the seasonal swing, and an advancement in phase which brings the "fall rise" and peak about one month earlier in 1913 than 1875. Too great stress should not be laid upon the minor differences revealed by Chart III, until consideration has been given to what follows, particularly the critical remarks in Section VII. Of the main features of the comparison there can, however, be no doubt: the considerable reduction in amplitude and the appreciable advancement in phase are conclusively shown.

CHART III. SEASONAL VARIATIONS IN COMMERCIAL PAPER RATES, IN 1875 AND IN 1914. (Link-relative method.)



The corresponding calculations were made according to the modified monthly-mean method. A preliminary estimate was formed from 12 charts, similar to Chart II; and lines of trend were fitted to the 12 series of actual data for the 12 months January to December. The central values and annual increments thus found are shown in columns 1 and 2 of Table III, and in columns 3 and 4 appear the corresponding

TABLE III

COMMERCIAL PAPER RATES. TERMINAL INDEXES OF SEASONAL VARIATION, MONTHLY-MEAN METHOD

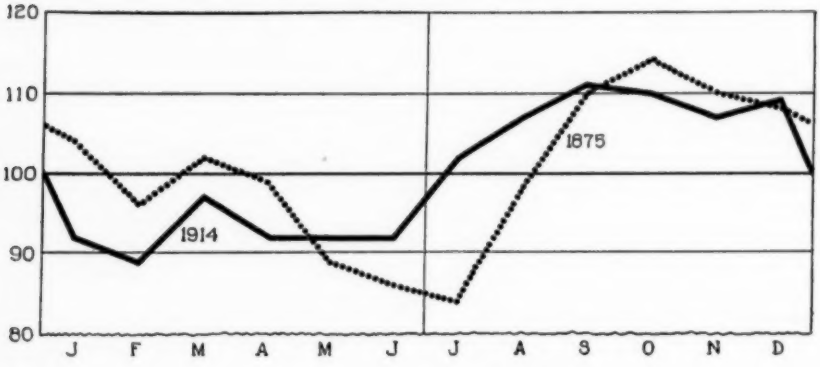
	Actual rates. (Unit: .01%)				Indexes for January 1	
	Central value	Annual increment	Ordinate for Jan. 1			
			1875	1914	1875	1914
Jan.	480.3	−3.06	538.6	419.2	104	92
Feb.	452.0	−2.22	494.5	407.8	96	89
Mar.	483.6	−2.03	522.6	443.4	102	97
Apr.	468.4	−2.31	513.0	422.8	99	92
May	439.7	−1.03	459.7	419.5	89	92
June	430.5	−.53	440.8	419.9	86	92
July	450.4	.84	434.0	466.7	84	102
Aug.	498.9	−.48	508.3	489.6	98	107
Sept.	538.5	−1.47	567.5	510.1	110	111
Oct.	548.3	−2.18	591.5	506.4	114	110
Nov.	529.0	−2.13	571.4	488.2	110	107
Dec.	528.6	−1.61	560.8	498.0	108	109

ordinates of trend for the beginning and end of the 39-year interval. Each item of column 5 is obtained by dividing the item for the same month in column 3 by the average of the 12 items of column 3, and multiplying by 100. Column 6 is derived in like manner from column 4.

Comparison of columns 5 and 6 of Table III, or of their graphic

representations in Chart IV, leads to conclusions substantially similar to those found by the link-relative scheme. The comparisons differ in detail, but in their main aspects they are the same: in both cases there is the sharp reduction in the range of variation and the moderate advancement in the timing of the movements.

CHART IV. SEASONAL VARIATIONS IN COMMERCIAL PAPER RATES, IN 1875 AND IN 1914. (Monthly-mean method.)



IV. BUSINESS FAILURES

Bradstreet's number of business failures is a series subject to marked seasonal swings, and might be expected to exhibit progressive changes in seasonality due to gradual readjustments in our economic organization.[1] The analysis was confined to the 15-year interval from August, 1899, to July, 1914. The years immediately before 1899 were characterized by frequent excessive fluctuations which clearly throw the data of those years out of line with the interval studied. The coming of the war in August, 1914, led to some months of exceptional movements in the failures data, and was followed shortly by a marked change in the general trend of the failures series.

Charts of link relatives, one chart for each of the 12 months, showed wide differences in the distributions. On the whole, the clustering of the plotted points along a line was not good, except in a few of the 12 months. There was no clear indication of any other form of trend than the straight line, and it was apparent from the charts that in several cases the appropriate straight line would be sharply inclined.

The calculations, for determining the 12 lines of trend and for finding the ordinates and the seasonal indexes for the beginning and end of the 15-year interval, were carried through; and the results, with important intermediate steps, appear in Table IV.

[1] Data for this series appear in *Review of Economic Statistics*, Prel. Vol. I, pp. 86–7.

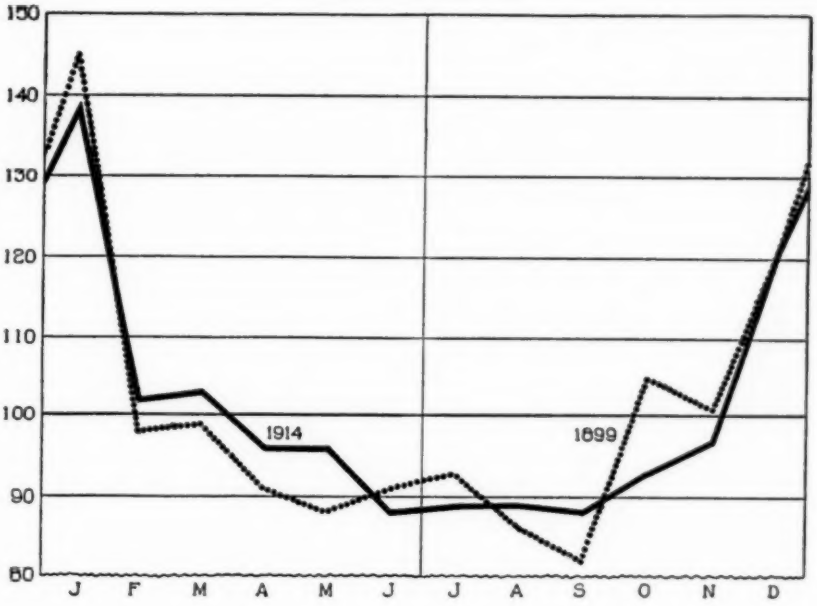
TABLE IV

BUSINESS FAILURES. TERMINAL INDEXES OF SEASONAL VARIATION, LINK-RELATIVE METHOD

	Link relatives				Adjusted indexes for August 1	
	Central value	Annual increment	Ordinate for Aug. 1			
			1899	1914	1899	1914
Jan.	117.1	−.36	119.8	114.4	145	138
Feb.	71.0	.48	67.4	74.6	98	102
Mar.	102.1	.05	101.7	102.5	99	103
Apr.	92.7	.14	91.6	93.7	91	96
May	98.3	.26	96.3	100.2	88	96
June	98.2	−.72	103.9	93.1	91	88
July	102.4	−.05	102.8	102.0	93	89
Aug.	96.1	.64	91.6	101.2	86	89
Sept.	97.1	.25	95.3	99.1	82	88
Oct.	117.8	−1.50	128.6	106.1	105	93
Nov.	101.3	.61	96.9	106.0	101	97
Dec.	122.4	.41	119.4	125.5	121	121

Comparison of the indexes for August 1, 1899 and 1914, is made in Chart V. It is evident that the amplitude of movement, particularly as regards the January peak, is less extensive in the later year; and the secondary peak in July nearly disappeared during the interval.

CHART V. SEASONAL VARIATIONS IN BUSINESS FAILURES, IN 1899 AND IN 1914. (Link-relative method.)



Minor changes in the index are scarcely significant, in view of the considerable approximations involved in fitting the several trends.

No examination of this series was made by the monthly-mean method. The shortness of the interval and the comparative frequency of irregular deviations increases the likelihood that results based on the monthly-mean method will be less satisfactory than those derived by the link-relative method. Further comment on this point will be found below (Section VII).

V. AVERAGE HOG WEIGHT

The average weight of hogs at Chicago is available monthly for many years, and is subject to a wide seasonal movement.[1] The interval analyzed extended from 1876 to 1914, inclusive. In the years after the outbreak of the war, there were considerable changes from the normal movement of earlier years, and the series was therefore broken at the end of 1914.

Twelve charts of link relatives, for the 12 individual months, showed exceptionally good clustering along lines of trend. In a few cases the clustering was less close than might be desired, and there were slight indications in some months that the trends might be curvilinear or that the links for the earlier years were unusually disturbed. On the whole, however, the graphic analysis pointed unmistakably to the conclusion that the trends of the several monthly series of links were rectilinear over the entire interval. The usual calculations were therefore made, and the results appear in Table V and Chart VI.

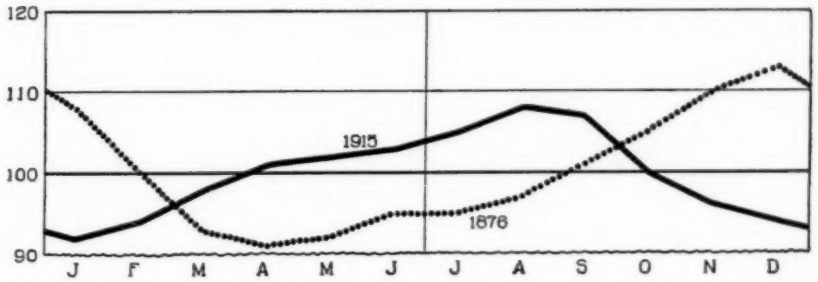
TABLE V

AVERAGE WEIGHT OF HOGS AT CHICAGO. TERMINAL INDEXES OF SEASONAL VARIATION, LINK-RELATIVE METHOD

	Link relatives				Adjusted indexes for January 1	
	Central value	Annual increment	Ordinate for Jan. 1			
			1876	1915	1876	1915
Jan.	97.2	.040	96.4	98.0	108	92
Feb.	97.2	.238	92.6	101.9	100	94
Mar.	98.4	.332	92.0	105.0	93	98
Apr.	100.3	.126	97.9	102.8	91	101
May	101.4	−.0077	101.6	101.2	92	102
June	101.6	−.065	102.9	100.3	95	103
July	101.1	.041	100.3	101.9	95	105
Aug.	102.4	.041	101.6	103.2	97	108
Sept.	101.7	−.123	104.1	99.3	101	107
Oct.	98.4	−.272	103.8	93.2	105	100
Nov.	100.6	−.254	105.7	95.7	110	96
Dec.	100.0	−.092	101.8	98.2	113	94

[1] Data for this series are given in the *Yearbook of Figures for 1923*, of the *Chicago Daily Drovers Journal*, p. 69.

CHART VI. SEASONAL VARIATIONS IN HOG WEIGHT, IN 1876 AND IN 1915. (Link-relative method.)



The chart reveals a slight reduction, during the 39-year interval, of the amplitude of the seasonal swing, but the principal change is the very striking shift of the whole movement to a position about 4 months earlier in the year. A more convincing manifestation of progressively changing seasonality could scarcely be found than this remarkable advance in phase of the smooth seasonal oscillation in hog weight.

Twelve monthly charts of the actual items of the hog weight series showed also clear evidences of substantially rectilinear trends, although the clustering along the lines was by no means as close as in the charts of link relatives. Straight lines were fitted to the twelve series, terminal ordinates and indexes were computed, and the results appear in Table VI and Chart VII. There are slight discrepancies between the results obtained by the two methods, but the main conclusion is

TABLE VI

AVERAGE WEIGHT OF HOGS AT CHICAGO. TERMINAL INDEXES OF SEASONAL VARIATION, MONTHLY-MEAN METHOD

	Actual weight. (Unit: 1 pound)				Indexes for January 1	
	Central value	Annual increment	Ordinate for Jan. 1			
			1876	1915	1876	1915
Jan.	234.2	—1.537	263.4	203.5	109	91
Feb.	227.0	—.899	244.2	209.1	101	93
Mar.	222.7	—.072	224.1	221.3	93	99
Apr.	223.4	.213	219.3	227.6	91	101
May	226.5	.222	222.2	230.9	92	103
June	230.3	.073	228.9	231.7	95	103
July	232.5	.167	229.2	235.8	95	105
Aug.	238.1	.243	233.3	242.8	97	108
Sept.	241.9	—.049	242.9	241.0	101	107
Oct.	237.7	—.683	251.2	224.6	104	100
Nov.	239.1	—1.288	264.7	214.5	110	96
Dec.	239.2	—1.516	269.4	210.3	112	94

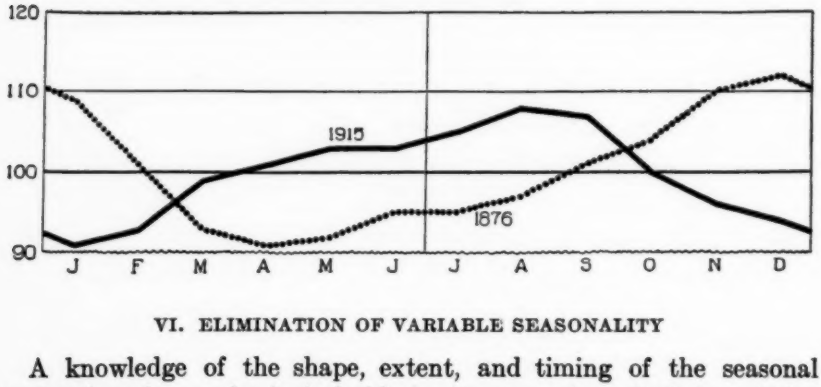
TABLE VII

Variability from trend, for average weight of hogs at Chicago, by link-relative (l-r) and monthly-mean (m-m) methods. (Unit: 1%, for ratio of the standard error of estimate to the central value)

	l-r	m-m
Jan.	3.0	5.3
Feb.	4.9	5.9
Mar.	3.4	5.0
Apr.	2.1	3.8
May	1.9	2.9
June	1.3	3.5
July	1.7	3.4
Aug.	2.2	3.7
Sept.	2.3	4.6
Oct.	2.3	4.2
Nov.	3.4	3.5
Dec.	2.8	4.0
Ave.	2.6	4.2

confirmed. Chart VII shows the slight compression in amplitude and the strong advancement in phase which appeared from Chart VI.

CHART VII. SEASONAL VARIATIONS IN HOG WEIGHT, IN 1876 AND IN 1915. (Monthly-mean method.)



VI. ELIMINATION OF VARIABLE SEASONALITY

A knowledge of the shape, extent, and timing of the seasonal fluctuations in a series is desirable for its own sake. Such knowledge is of great value in interpreting current data and in planning for the immediate future. It is quite to be expected that, as the realization of the non-uniformity inherent in economic *cycles* and of the inadequacy of statistical measures for such cycles becomes more widespread, there will develop a stronger demand for seasonal *standards* applicable to the study of current phenomena.[1]

It is improbable, however, that the study of cyclical movements will be relaxed; and the problem therefore arises of devising means by which to correct a series for variable seasonality. Series in which a clear-cut changing seasonal variation can be detected and measured are rarely found, but it may well be desired to eliminate such variable seasonal effects where they appear. Methods, although infrequently used, will probably improve with experience; and the procedure outlined below must be regarded as preliminary in form. The methods here suggested will be presented in the course of their actual application to the illustrative examples.

In any instance, such as the hog weight series, for which the scheme developed from the monthly-mean method is adequate, the process of elimination is exceedingly simple. Moreover, there is no occasion to compute the actual indexes of seasonal variation. All that is necessary is: (1) to find the 12 groups of monthly ordinates of trend, one group for each month of the year; and (2) to divide each original item by the

[1] The writer is indebted to Professor H. B. Vanderblue for the emphatic statement of this phase of the seasonality problem. (See *Railway Age*, March 22 and April 5, 1924.)

corresponding ordinate of trend. The resulting ratios set forth the cyclical fluctuations in the series, for the process corrects simultaneously for both trend and seasonality.

The difficulties become more serious in cases in which the link relatives must be used, as is desirable in nearly all instances where cyclical and irregular movements are considerable. This is the situation in the interest rate series: in that series the cyclical and irregular fluctuations are much more extensive than for the hog weight series. For this reason chiefly the monthly-mean method is less acceptable for the interest rate study. Use of the link-relative scheme necessitates, however, actual calculation of the seasonal indexes; and it is here that the difficulties arise.

It has been remarked that the adjusted index of seasonal variation for any one month depends cumulatively upon the typical link relatives of all 12 months. Hence, strictly, determination of the seasonal index for January, 1875, involves finding 12 links (individual ordinates of trend) for that date and "adjusting" them to yield the index. Then the index for February, 1875, requires a complete repetition of the process, and so on for *all* 468 months of the 39 years. The labor in this process is obviously prohibitive; and, although it is presumably possible to devise an interpolating scheme (based upon the examination of small differences) for estimating changes in the adjusted indexes due to slight changes in the links, a much briefer plan is needed.

Clearly, the solution lies in the observation that such progressive changes as occur in seasonality take place very slowly. Hence, the change in the seasonal indexes during any one year may be assumed negligible. In the case of the interest rate series the seasonal index may be "centered" at the middle of a year for all months of that year. Thus, the 12 indexes for the year 1875 would stand as of July 1, 1875. It is doubtful if the error due to this "centering" will exceed .2 per cent in any one month, and an error of that size must be disregarded in such problems.[1]

[1] It might be suggested that each of the 12 links should be "centered" on its proper month, and that a single seasonal index for the one year should then be computed. This proposition carries certain theoretical implications which it is not desired, at present, to examine. Practically, the result will not differ greatly from those obtained by centering at the middle of the year.

If the trend of the entire interest rate series had not been substantially horizontal, the original items would first have been expressed as ratios to the respective ordinates of trend (the trend for the complete series), and these ratios would then have been corrected for seasonal variation by subtraction of the seasonal indexes. Actually, the correction consisted in subtracting from the actual item the product of the seasonal index (minus 100%) by .04874.

VII. FURTHER COMMENTS ON METHOD

(1) In view of the undoubtedly greater ease which attends the use of the monthly-mean method, the question will be raised whether it is not as satisfactory as the link-relative scheme. It has already been remarked that, especially in series in which cyclical and irregular fluctuations are comparatively heavy, the monthly-mean results are more likely to be subject to the irregular deviations.[1]

Although it is possible to form an approximate opinion as to the comparative reliability of the two methods by examining the trend charts (such as Charts I and II) with a view to estimating the closeness of clustering, a numerical comparison is desirable. To obtain such a numerical measure, the trend problem is regarded as a case of regression. The departures of the actual points from the line of trend are then *errors of estimate.* The measure of the average error of estimate in a case of rectilinear regression is the *standard error of estimate.* This is $\sigma_y\sqrt{1-r^2}$ where σ_y is the standard deviation of the dependent variable (the variable other than the time) and r is the coefficient of correlation. Since the annual increment in the trend problem is the *slope* of the line of regression, r is the product of the annual increment by σ_t/σ_y (σ_t is the standard deviation of the time). Using these relations, one can obtain the standard error of estimate for any one of the monthly trends.

A comparison between two such standard errors of estimate is attended by the same difficulties as a direct comparison between the standard deviations of two series. A similar remedy is appropriate here: the standard error of estimate for any trend is divided by the central value of that trend. The result will be designated tentatively as the *variability from trend,* and will serve as an adequate measure for purposes of comparison.

Table VII shows the variabilities from trend for each month, according to both methods, for the hog weight series. It is at once apparent that, on the basis of this comparison, the link-relative method is the more reliable. In a series with relatively small cyclical and irregular movements (such as the hog weight series) the differences between the two methods will not prove large; but, as cycles and irregularities assume greater importance, the higher reliability of the link-relative method may well become quite significant. It was this consideration which led to the decisions not to use the monthly-mean method for the business failures series, and to prefer the link-relative method for the interest rate series.

(2) Examination of certain of the monthly trend-charts revealed

[1] The general aspects of this point are discussed by Professor H. D. Falkner, this JOURNAL, June, 1924.

indications that these trends might not be rectilinear. Although this evidence was quite strong in a few instances, it was decided on the whole to disregard the possibility of curvilinear trends in the seasonals actually studied. Unless curvature is very considerable, a straight line as fitted will ordinarily eliminate much of a trend which is truly curvilinear: the straight line is a good "first approximation."

There is, however, nothing in the method as outlined which prevents the use of curvilinear trends. In any instance in which one or more months clearly has a curved trend, such trend may be fitted in the usual way, and the rest of the analysis proceeds as outlined in preceding sections.

(3) Much has been written concerning the dangers involved in determining seasonal indexes by the use of all available data, irregular as well as regular. These dangers account largely for the persistent use of the *median* in a large number of seasonal variation analyses. It is of course evident that secular trend, as determined above by the least-squares method, partakes of the nature of the mean rather than the median. It depends in part upon every item of the data, and in this problem is peculiarly subject to irregular items. The reason for this is that an annual series of isolated monthly items is more liable to irregularities than an annual series of aggregates (or averages) of continuous monthly items. This is due to the observed condition that irregular economic disturbances seldom extend over several months, and are therefore largely lost in annual totals.

For series likely to be highly irregular, the least-squares determination of trend is open to serious question, both as respects direction (annual increment) and general level (central value). Inquiry has been made into the nature of the frequency distributions upon which trend determinations are based, but no general device for removing the apparent faults of the method has yet been developed.

Some experiments, touching the three series reviewed in this article, have been carried out with modifications of the least-squares method, as suggested by the above-mentioned inquiry; but satisfactory results have not yet been obtained. For the present no positive proposal, regarding the possible improvement of the trend determinations in the seasonality problem, is made. Notice is taken of the obvious shortcomings of the standard practice, but no substitute is yet available.

VIII. CONCLUSIONS

The foregoing sections define the problem of progressive variation in seasonality, present and criticize methods for measuring such change,

and exhibit examples in which such change is clearly present. Attention is called also to the larger theoretical aspects of the problem, and to the general question of the variation in the economic cause-complex.

It is believed that the evidence presented points conclusively to the existence of marked long-time changes in the seasonal variation of certain economic factors. It is probable that further instances of varying seasonality will be found as the tests are applied to additional series of economic data.

The significance of the particular variation in seasonality, in any one series, has not been examined; but a reasonable interpretation of the observed facts is presumably possible in each case. There remains also the larger problem of the general import of progressive modification of the totality of seasonal variations in the entire economic structure. Here the solution must wait upon further analyses of individual components, and indeed upon the previous construction of some comprehensive index of total seasonality. A problem of this magnitude may well lie beyond the reach of present statistical implements; but there is no reason to doubt that in time it will be solved, at least approximately. That the solution ultimately found will reflect a gradual adaptation, of the economic utilization of the seasonally variable natural environment, to the needs of men is confidently to be expected.

THE MAJOR TRENDS OF BOND PRICES

By McDonald H. Wilson, *The Brookmire Economic Service*

Investors, both private and corporate, are interested in the major trends of bond prices in order that they may profitably plan their investment policies. When the major trend of bond prices is either upward or horizontal, it is profitable for the investor to hold long-term bonds. When the major trend is downward, it is to the advantage of the investor to hold bonds and notes which will mature within a very short time.

A method by which the major trends of bond prices can be forecast, with sufficient accuracy to be of practical value, is based upon changes in:

1. The prices of stocks.
2. The general level of commodity prices.
3. The commercial paper rate.

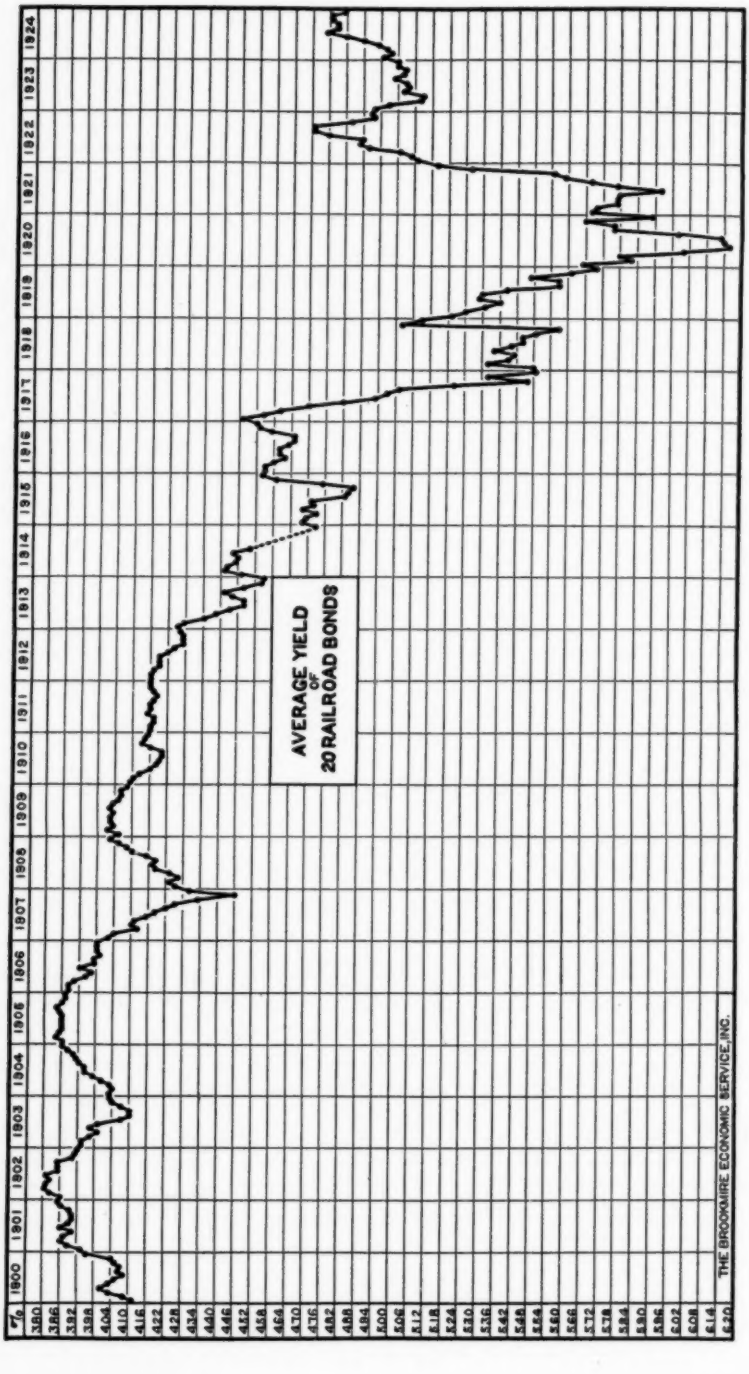
The method does not involve the use of a normal line or any correction for seasonal variation. It is based upon direction of movement and extent or duration of movement.

The data are prepared as follows:—

1. The prices of stocks. The prices of stocks are based upon the prices of railroad stocks as one group and of industrial stocks with public utility stocks as another group. From January, 1900, to date, the railroad group consists of 20 stocks. From January, 1900, through December, 1914, the industrial-utility group consists of 12 stocks; from January, 1915, through September, 1916, of 11 stocks; from October, 1916, to date, of 20 stocks. The changes in the number of stocks in the group were made at such times that the continuity of the averages was maintained.

The daily price of each group of stocks is a simple arithmetic average of the closing bid prices of the stocks of the group. The monthly price of each group is a simple arithmetic average of the daily prices of the group. The monthly price of stocks is a weighted arithmetic average of the monthly prices of the two groups.

The weights used in the preparation of the monthly prices of stocks are based upon the number of shares of each group traded on the Exchange. The weights for any given month are the number of shares of each group traded during the twelve months ending with the given month. All data pertaining to stocks are based upon transactions on the New York Stock Exchange.


AVERAGE YIELD
OF
20 RAILROAD BONDS
THE BROOKMIRE ECONOMIC SERVICE, INC.

Each monthly price of stocks is expressed as a percentage of the price of stocks for the preceding month, and a six months sliding average of these percentages is prepared. In the following discussion, this six months sliding average will be termed "Stock Prices" and will be considered one of two primary factors.

It should be noted that the Exchange was closed for four and a half months during 1914 (July 31 to December 11, both inclusive). In preparing the percentage relations, the price of stocks for December, 1914, was expressed as a percentage of the price of stocks for July of that year.

2. The general level of commodity prices. (a) Each monthly index of *Bradstreet's Index of Commodity Prices* is expressed as a percentage of the index for the preceding month. Hereinafter, this series of percentages will be termed "Bradstreet's Index" and will be considered one of two secondary factors.

(b) The monthly percentage relations of *Bradstreet's Index of Commodity Prices* are expressed as a six months sliding average. Hereinafter, this six months sliding average will be termed "Commodity Prices" and will be considered one of two primary factors.

3. The commercial paper rate. The mid-point of the weekly quotation of prime commercial paper, single names, four to six months, is used. Hereinafter, that mid-point will be termed the "Commercial Paper Rate," and will be considered one of two secondary factors. The quotations are those published in the *Commercial and Financial Chronicle.*

The method by which these four factors, expressed as above indicated, can be used to forecast the major trends of bond prices is as follows:—

1. When Stock Prices remain on a flat or decline for three consecutive months, and when Commodity Prices decline one (1.00) per cent, the major trend of bond prices will thereafter be upward. These two primary factors are sufficient to indicate an upward trend. (This decline in Commodity Prices is cumulative; for example, decline May 1, 1903, was 0.27 per cent; June 1, 0.55 per cent; July 1, 0.43 per cent; total decline July 1, 1.25 per cent).

2. A major downward trend of bond prices is not so readily indicated. Both Stock Prices and Commodity Prices may increase month after month, without indicating that the upward movement of bond prices is at an end. The bond market of 1922 is an example of such a situation. However, when Stock Prices increase for three consecutive months; and when Commodity Prices increase one and one-half (1.50) per cent; and when two secondary factors are in evidence; the major trend of bond prices will thereafter be downward. (This increase in Commodity Prices is cumulative).

The two secondary factors are: (a) An increase of one (1.00) per cent in Bradstreet's Index during a single month, following the gain of one and one-half (1.50) per cent in Commodity Prices. In this factor only, ninety-five one-hundreths (0.95) of one per cent will be considered equivalent to one per cent. (b) Any increase in the Commercial Paper Rate, following both the increase for three consecutive months in Stock Prices and the increase of one and one-half (1.50) per cent in Commodity Prices.

Let us apply this method to the bond market of the past twenty-four years, using a composite of twenty high-grade railroad bonds to represent the bond market. It will be convenient, while reading the following discussion, to refer to the chart indicating, through yields, the trends of the prices of the composite of bonds, printed on page 66. For practical purposes it may be assumed that the investor would buy or sell long-term bonds within thirty days after the change in the major trend of bond prices had been indicated.

During the last half of 1900 and the first half of 1901, Commodity Prices declined, and not until December 1, 1901, did Commodity Prices increase one and one-half per cent. During February, 1902, Bradstreet's Index increased one per cent (exact percentage 0.97). By the end of April, 1902, Stock Prices had increased for three consecutive months. The Commercial Paper Rate increased the first week of May, and a major downward trend of bond prices had been indicated.

Not until July 1, 1903, had Commodity Prices declined one per cent, but at that time Stock Prices had declined for three consecutive months. A major upward trend of bond prices had then been indicated.

Early in 1904, Commodity Prices increased one and one-half per cent, but not until the end of September did Stock Prices rise for three consecutive months, and by that time Commodity Prices had lost the entire increase. Throughout the last half of 1904 and the entire year 1905, Stock Prices increased. By January 1, 1905, Commodity Prices had again increased one and one-half per cent. The Commercial Paper Rate increased during March. During July, Bradstreet's Index gained one per cent, and a major downward trend of bond prices had again been indicated.

Throughout 1907, Stock Prices declined abruptly. By November 1, Commodity Prices had declined one per cent. The investor would have purchased bonds during November, 1907.

Throughout the greater part of 1908 and all of 1909, Stock prices continued to rise. By January 1, 1909, Commodity Prices had increased one and one-half per cent. Late in February the Commercial Paper Rate increased, and during March Bradstreet's Index gained one per

cent. During April, 1909, the investor would have based his investment policy upon the expectation of a major downward trend of bond prices.

By August 1, 1910, both Stock Prices and Commodity Prices indicated that a major upward trend of bond prices might be expected. As a matter of fact, the prices of bonds increased for some two months, then declined slightly and remained on a flat for approximately a year.

By November 1, 1911, Commodity Prices had increased one and one-half per cent and continued to rise steadily throughout 1912. During November, 1911, and again in March, 1912, Bradstreet's Index increased one per cent. During May, 1912, Stock Prices increased for the third consecutive month. During the latter part of June, the Commercial Paper Rate increased, indicating a major downward trend in the bond market.

Both Stock Prices and Commodity Prices indicated that June, 1913, was the time at which to purchase bonds. Not so opportune a time as December of the same year? That is quite true.

Obviously, the sale of bonds in the spring of 1914 would have been a very desirable policy in the light of events, as they afterward occurred. The investor, guided by this method would not have been so fortunate; he would have owned long-term bonds at the outbreak of the war. However the method did not indicate that the sale of bonds was advisable during the subsequent period of demoralization in the security markets.

During the latter part of 1914 and during 1915, Commodity Prices increased rapidly and in each of several months Bradstreet's Index gained one per cent. But not until the end of August, 1915, did Stock Prices increase for three consecutive months, and thereafter in December, the Commercial Paper Rate increased. Guided by this method, the investor would have sold bonds the latter part of December, 1915.

Thereafter for four and a half years, Stock Prices and Commodity Prices together did not indicate that the major trend of bond prices would be upward. The investor, whose capital was invested in high grade short-term paper during that period, followed a very profitable investment policy.

By July 1, 1920, both Stock Prices and Commodity Prices indicated that a major upward trend of bond prices was at hand.

Thereafter, not until 1922, did both Stock Prices and Commodity Prices indicate that consideration need be given to the secondary factors. By December 1, 1921, Commodity Prices had increased one and one-half per cent, and in February, 1922, Stock Prices increased for the third consecutive month. Several times during 1922, Bradstreet's Index increased one per cent per month. But the trend of the Commercial Paper Rate was steadily downward, and not until August did the rate increase,

thereby indicating that the remarkable upward movement in the prices of bonds during the past two years was at an end.

By July 1, 1923, both Stock Prices and Commodity Prices again indicated that a major upward trend of bond prices was at hand.

By November 1, 1924, Stock Prices had increased for three consecutive months and Commodity Prices had increased one and one-half per cent. During the third week of November, the Commercial Paper Rate increased, while during the month of November Bradstreet's Index gained one per cent. A major downward trend of bond prices had again been indicated.

TABLE I

"STOCK PRICES"

Each monthly price of stocks is expressed as a percentage of the price of stocks for the preceding month. The percentages are expressed as a six months sliding average, shown in this table.

	1901	1902	1903	1904	1905	1906	1907	1908
Jan.		99.9	100.0	98.9	103.4	102.0	101.0	97.2
Feb.		100.2	99.6	99.0	103.6	101.0	99.2	97.8
Mar.		100.3	98.6	99.3	103.5	100.5	97.1	98.7
Apr.		101.1	98.7	100.6	102.5	100.2	97.3	100.8
May		100.5	99.2	100.1	100.6	99.7	96.9	103.5
June	104.2	100.8	98.3	99.5	100.7	99.2	96.3	102.6
July	102.4	101.3	96.9	100.1	101.1	98.1	97.6	102.3
Aug.	101.7	101.5	96.4	101.1	101.1	99.5	96.8	104.0
Sept.	101.3	101.7	96.8	101.8	100.6	100.5	98.5	103.0
Oct.	99.6	100.6	96.4	102.5	100.6	100.5	96.9	102.6
Nov.	100.0	100.0	96.5	103.8	101.6	101.1	95.6	102.6
Dec.	98.8	100.0	98.1	103.8	102.1	101.0	97.0	102.8

	1909	1910	1911	1912	1913	1914	1915	1916
Jan.	102.2	99.4	100.8	99.0	99.1	100.7	98.1	102.0
Feb.	101.2	98.2	101.1	99.8	98.2	100.4	98.1	101.1
Mar.	101.2	98.7	100.9	101.0	97.9	99.8	98.2	100.7
Apr.	101.8	98.6	100.1	101.4	98.1	99.9	99.4	99.3
May	101.1	98.4	100.4	100.6	98.0	100.3	99.1	99.1
June	101.2	97.8	101.3	100.6	97.8	100.3	101.1	99.2
July	101.3	97.6	100.9	100.5	98.4	99.3	100.5	99.2
Aug.	102.0	98.2	99.6	101.0	99.5		101.4	99.9
Sept.	102.0	97.8	99.1	100.5	100.2	Exchange	101.6	100.9
Oct.	101.0	99.0	99.2	100.0	99.4	Closed	101.4	102.0
Nov.	100.5	99.3	99.5	99.8	99.5		102.5	102.4
Dec.	100.2	99.4	99.1	99.3	100.3	97.6	101.8	101.4

	1917	1918	1919	1920	1921	1922	1923	1924
Jan.	101.1	96.8	100.0	99.0	97.6	102.1	100.1	101.1
Feb.	99.8	98.1	100.0	98.7	98.3	103.0	100.3	101.2
Mar.	99.5	99.0	100.8	98.8	97.6	103.3	100.4	100.8
Apr.	98.2	99.8	100.7	98.0	97.7	103.9	99.9	100.4
May	97.5	101.9	102.3	96.9	99.3	103.4	100.0	99.9
June	99.2	102.4	103.6	97.6	99.1	102.6	99.5	99.7
July	99.1	101.2	104.5	97.7	98.5	102.8	98.6	100.1
Aug.	99.6	100.5	103.3	98.4	98.3	102.7	98.1	100.8
Sept.	97.8	100.8	103.0	98.1	99.2	102.0	97.7	101.1
Oct.	97.3	101.6	103.3	97.9	99.1	101.4	97.9	101.5
Nov.	96.0	100.8	101.5	98.1	99.7	100.1	99.1	102.6
Dec.	94.8	100.4	99.8	96.8	101.9	100.4	100.0	103.3

TABLE II

"BRADSTREET'S INDEX"

Each monthly index of *Bradstreet's Index of Commodity Prices* is expressed as a percentage of the index for the preceding month. The percentages are shown in this table. (Bradstreet's Index of Commodity Prices is dated the first of each month.)

	1900	1901	1902	1903	1904	1905	1906	1907	1908
Jan.		98.30	99.13	99.23	101.92	100.31	100.33	100.17	97.31
Feb.	102.66	100.01	100.37	100.04	101.36	99.97	98.95	100.88	98.00
Mar.	99.90	99.81	100.97	100.59	99.89	100.22	99.88	101.49	98.24
Apr.	98.85	99.64	100.27	99.93	98.53	98.79	100.81	98.19	100.99
May	98.36	98.73	101.27	97.93	99.58	99.63	100.08	99.68	98.73
June	97.68	99.83	99.83	98.97	98.14	99.21	100.18	100.61	96.98
July	98.88	101.31	99.60	99.94	98.00	100.11	99.56	100.57	101.29
Aug.	100.13	100.94	100.48	98.43	101.71	102.46	100.65	98.78	101.41
Sept.	99.05	100.26	100.66	100.14	100.29	102.08	101.38	98.87	99.65
Oct.	101.21	101.61	100.82	101.93	101.76	99.40	101.24	100.24	101.38
Nov.	98.67	99.26	101.21	99.47	101.01	99.76	102.25	98.83	100.67
Dec.	100.66	100.74	100.64	99.63	100.70	101.12	101.73	97.46	101.81

	1909	1910	1911	1912	1913	1914	1915	1916
Jan.	100.31	101.15	100.59	99.63	99.45	96.28	101.19	102.53
Feb.	100.47	98.29	99.21	100.09	99.64	99.73	105.68	102.06
Mar.	98.97	100.42	99.15	99.38	99.43	99.66	99.56	102.10
Apr.	101.20	100.97	98.05	102.20	98.86	99.14	101.62	103.37
May	99.83	98.25	99.25	101.89	98.30	98.47	100.23	99.90
June	101.14	98.58	100.84	98.19	99.26	100.00	99.44	99.49
July	100.73	100.16	100.75	100.11	98.68	100.40	101.30	98.64
Aug.	100.55	98.85	100.74	100.52	100.66	100.60	99.51	99.24
Sept.	101.02	101.47	101.87	100.61	100.99	112.04	99.82	102.96
Oct.	101.83	99.72	99.86	102.56	100.57	94.72	101.78	102.20
Nov.	102.47	99.52	100.97	100.28	100.79	95.89	104.00	106.31
Dec.	101.82	98.88	101.01	100.72	100.04	101.96	102.61	106.75

	1917	1918	1919	1920	1921	1922	1923	1924
Jan.	100.48	101.97	97.47	100.93	92.93	100.53	99.40	98.77
Feb.	101.57	100.60	95.14	102.48	97.68	100.41	100.16	99.44
Mar.	101.39	100.00	97.68	99.65	95.93	101.59	101.53	97.72
Apr.	103.12	102.17	100.32	99.60	95.87	99.41	99.98	98.15
May	103.73	102.43	99.76	100.10	95.13	101.50	98.11	99.20
June	102.30	100.48	104.95	95.86	98.12	101.70	97.93	97.90
July	103.88	100.95	104.46	97.37	101.05	101.71	97.80	99.45
Aug.	102.06	99.64	105.85	97.28	103.07	99.69	97.94	103.25
Sept.	101.50	99.65	97.35	95.47	100.26	100.09	100.73	101.48
Oct.	101.62	99.83	100.25	94.07	100.91	103.52	101.42	101.48
Nov.	100.93	99.44	101.95	92.70	101.46	106.75	100.31	102.70
Dec.	103.08	100.67	101.37	86.93	99.66	103.26	102.27	101.34

TABLE III

"COMMODITY PRICES"

Each monthly index of *Bradstreet's Index of Commodity Prices* is expressed as a percentage of the index for the preceding month. The percentages are expressed as a six months sliding average, shown in this table.

	1900	1901	1902	1903	1904	1905	1906	1907	1908
Jan.		99.67	100.32	100.51	100.25	100.96	100.86	101.24	98.58
Feb.		99.65	100.23	100.43	100.74	100.67	100.27	101.28	98.45
Mar.		99.78	100.35	100.42	100.70	100.66	99.91	101.29	98.35
Apr.		99.52	100.12	100.27	100.13	100.17	100.14	100.79	98.47
May		99.53	100.46	99.73	100.15	99.94	100.20	100.36	98.46
June		99.39	100.31	99.45	99.90	99.69	100.04	100.17	98.38
July	99.39	99.89	100.39	99.57	99.25	99.65	99.91	100.24	99.04
Aug.	98.97	100.04	100.40	99.30	99.31	100.07	100.20	99.89	99.61
Sept.	98.83	100.12	100.35	99.22	99.38	100.38	100.44	99.45	99.84
Oct.	99.22	100.45	100.44	99.56	99.91	100.48	100.52	99.79	99.91
Nov.	99.27	100.53	100.43	99.81	100.15	100.50	100.88	99.65	100.23
Dec.	99.77	100.69	100.57	99.92	100.58	100.82	101.14	99.13	101.04

	1909	1910	1911	1912	1913	1914	1915	1916
Jan.	100.92	101.47	99.84	100.68	100.69	99.89	101.07	101.71
Feb.	100.77	101.10	99.90	100.57	100.54	99.73	101.91	102.13
Mar.	100.65	101.00	99.51	100.16	100.35	99.51	99.83	102.51
Apr.	100.62	100.85	99.23	100.55	99.73	99.27	100.98	102.78
May	100.48	100.15	99.19	100.70	99.40	98.89	101.71	102.10
June	100.37	99.61	99.52	100.23	99.16	98.88	101.29	101.58
July	100.39	99.45	99.54	100.31	99.03	99.57	101.31	100.93
Aug.	100.40	99.54	99.80	100.38	99.20	99.71	100.28	100.46
Sept.	100.75	99.71	100.25	100.59	99.46	101.78	100.32	100.60
Oct.	100.85	99.51	100.55	100.65	99.74	101.04	100.35	100.41
Nov.	101.29	99.72	100.84	100.38	100.16	100.61	100.98	101.47
Dec.	101.40	99.77	100.87	100.80	100.29	100.94	101.50	102.68

	1917	1918	1919	1920	1921	1922	1923	1924
Jan.	102.99	101.86	99.45	101.28	93.23	100.98	102.12	100.24
Feb.	103.38	101.62	98.70	100.72	93.30	100.54	102.20	100.49
Mar.	103.12	101.37	98.37	101.11	93.37	100.76	102.44	99.99
Apr.	103.27	101.46	98.45	101.00	93.67	100.51	101.85	99.44
May	102.84	101.71	98.51	100.69	94.08	100.52	100.41	99.26
June	102.10	101.28	99.22	99.77	95.94	100.86	99.52	98.53
July	102.67	101.11	100.39	99.18	97.30	101.05	99.25	98.64
Aug.	102.75	100.95	102.17	98.31	98.20	100.93	98.88	99.28
Sept.	102.77	100.89	102.12	97.61	98.92	100.68	98.75	99.91
Oct.	102.52	100.50	102.10	96.69	99.76	101.37	98.99	100.46
Nov.	102.05	100.00	102.47	95.46	100.81	102.24	99.36	101.04
Dec.	102.18	100.03	101.87	93.97	101.07	102.50	100.08	101.62

TABLE IV

"COMMERCIAL PAPER RATE"

Prime Commercial Paper—Single Names—4 to 6 Months

Week ending	Quotation	Mid-point
1902		
Apr. 4	4½–5	4.75
11	4¾–5¼	5.00
18	4¾–5¼	5.00
25	4¼–4¾	4.50
May 2	4½–5¼	4.88
9	4½–5	4.75
16	4½–5	4.75
23	4½–5	4.75
29	4¼–4¾	4.50
1905		
Jan. 6	4 –4½	4.25
13	4 –4½	4.25
20	3¾–4¼	4.00
27	3¾–4¼	4.00
Feb. 3	3¾–4¼	4.00
10	3¾–4¼	4.00
17	3¾–4¼	4.00
24	3¾–4¼	4.00
Mar. 3	4 –4¼	4.13
10	4 –4½	4.25
17	4 –4½	4.25
24	4 –4½	4.25
31	4 –4½	4.25
1909		
Jan. 8	3¾–4	3.88
15	4 –4½	4.25
22	4 –4	4.00
29	3½–4	3.75
Feb. 5	3½–4	3.75
12	3½–4	3.75
19	3¾–3¾	3.75
26	4 –4	4.00
Mar. 5	3¾–4	3.88
12	3¼–4	3.63
19	3½–4	3.75
26	3¾–4	3.88
1912		
May 3	4 –4½	4.25
10	4 –4½	4.25
17	4 –4½	4.25
24	4 –4½	4.25
31	3¾–4½	4.13
June 7	3¾–4	3.88
14	3¾–4	3.88
21	4 –4¼	4.13
28	4 –4¼	4.13
July 5	4 –4¼	4.13
12	4½–4¾	4.63
19	4½–4¾	4.63
26	4½–5	4.75
1915		
Aug. 6	3½–3¾	3.63
13	3¼–3¾	3.50
20	3¼–3¾	3.50
27	3¼–3¾	3.50
Sept. 3	3¼–3¾	3.50
10	3 –3½	3.25
17	3 –3½	3.25
24	3 –3½	3.25
Oct. 1	3 –3½	3.25
8	3 –3½	3.25
15	3 –3½	3.25
22	3 –3½	3.25
29	3 –3¼	3.13
1915.—*Continued*		
Nov. 5	3 –3¼	3.13
12	3 –3¼	3.13
19	2¾–3	2.88
26	2¾–3	2.88
Dec. 3	2¾–3	2.88
10	3 –3¼	3.13
17	3 –3¼	3.13
24	3 –3¼	3.13
31	3 –3¼	3.13
1922		
Jan. 6	4¾–5	4.88
13	4¾–5	4.88
20	4¾–5	4.88
27	4¾–5	4.88
Feb. 3	4¾–5	4.88
10	4¾–5	4.88
17	4¾–5	4.88
24	4¾–5	4.88
Mar. 3	4¾–5	4.88
10	4¾–5	4.88
17	4¾–5	4.88
24	4½–4¾	4.63
31	4½–4¾	4.63
Apr. 7	4½–4¾	4.63
14	4½–4¾	4.63
21	4½	4.50
28	4½	4.50
May 5	4¼	4.25
12	4¼	4.25
19	4¼	4.25
26	4¼	4.25
June 2	4¼	4.25
9	4	4.00
16	4	4.00
23	4	4.00
30	4	4.00
July 7	4	4.00
14	4	4.00
21	3¾–4	3.88
28	3¾–4	3.88
Aug. 4	4	4.00
11	4	4.00
18	3¾–4	3.88
25	3¾–4	3.88
Sept. 1	3¾–4	3.88
8	4 –4¼	4.13
15	4 –4¼	4.13
22	4¼–4½	4.38
29	4¼–4½	4.38
1924		
Sept. 5	3 –3¼	3.13
12	3 –3¼	3.13
19	3 –3¼	3.13
26	3 –3¼	3.13
Oct. 3	3 –3¼	3.13
10	3 –3¼	3.13
17	3 –3¼	3.13
24	3 –3¼	3.13
31	3 –3¼	3.13
Nov. 7	3 –3¼	3.13
14	3 –3¼	3.13
21	3¼–3½	3.38
28	3¼–3½	3.38
Dec. 5	3¼–3½	3.38
12	3½–3¾	3.63
19	3½–3¾	3.63
26	3½–3¾	3.63

NOTES

FORMULAE FOR FACILITATING COMPUTATIONS IN TIME SERIES ANALYSES

By Frank Alexander Ross, *Columbia University*

In the field of statistics there are many uses for summations of progressions. The sums most commonly required are those of the first six powers of the first t natural numbers and of the first t *odd* natural numbers.

The most usual application is in time series analyses where straight lines and more complex curves are fitted as "secular trends." Ordinarily time is represented as the horizontal variable, X, and magnitudes of the phenomenon under observation as the vertical variable, Y. The mean of X is usually assumed to be at the middle time point, if the number of time points is odd; or mid-way between the central pair of time points, if the number is even.

Deviations, plus and minus, are in the first instance 1, 2, 3, 4, 5, etc., time units, and in the second 1, 3, 5, 7, 9, etc., half time units. The summations of the deviations themselves or of their second, third or higher powers are essential in determining the constants in the equations of the various curves. That is, the values of Σx, Σx^2, Σx^3, Σx^4, etc., are dependent upon the summations of the progressions of powers either of the first t integers or of the first t *odd* integers.

Tables of the summations of powers of the first t natural numbers have been prepared. The best known are those available in "Tables for Statisticians and Biometricians," edited by Karl Pearson (Cambridge University Press, pages 40 and 41), which give the summations of the first seven powers of the natural numbers to $t = 100$. The writer knows of no similar tables for such powers of the *odd* natural numbers.[1]

Since many statisticians do not have readily available this volume of tables, and since in some problems, where long series of weekly or monthly data are used, the values of t are greater than 100, and because the summations of the various powers of the first t *odd* integers have not been tabulated, laborious computations are often necessary. It

[1] The sum of the powers of the first t *odd* natural numbers can be found from tables of the summations of the same powers of the complete natural series. In the table of summations of the complete series look up the sum of the first $2t$ integers. From this subtract the sum of the first t integers times 2^n, n being the power involved in the summation.

seems worth while to give the simple formulae from which these summations may be evolved far more easily and quickly than by the lengthy method of tabulation.

If t denotes the total number of terms in the series 1, 2, 3, 4, 5, . . . t; and if S_1, S_2, S_3, S_4, S_5, and S_6 denote the sums of the first, second, third, fourth, fifth and sixth powers of these numbers, then it can be shown that:[2]

[1] The derivations of these formulae are simple.
To find the sum of the first t natural numbers:

Let S_1 denote $1+2+3+ \ldots +t$.

To prove that $S_1=\frac{t(t+1)}{2}$;

$$S_1=1+2+3+4+ \ldots +t;$$
$$\text{Also } S_1=t+(t-1)+(t-2)+(t-3)+ \ldots +1;$$
$$\text{Adding: } 2S_1=(t+1)+(t+1)+(t+1)+(t+1)+ \ldots +(t+1).$$

Since there are t terms

$$2S_1=t(t+1);$$
$$S_1=\frac{t(t+1)}{2}.$$

To find the sum of the squares of the first t natural numbers:

Let S_2 denote $1^2+2^2+3^2+ \ldots +t^2$.

To prove that $S_2=\frac{t(t+1)\ (2t+1)}{6}$.

Setting down the cubes of the successive numbers, subtracting the next lower number and expanding these differences we have:

$$t^3-(t-1)^3=t^3-t^3+3t^2-3t+1$$
$$=3t^2-3t+1$$
$$(t-1)^3-(t-2)^3=(t-1)^3-[(t-1)-1]^3=(t-1)^3-(t-1)^3+3(t-1)^2-3(t-1)+1$$
$$=3(t-1)^2-3(t-1)+1$$
$$(t-2)^3-(t-3)^3=(t-2)^3-[(t-2)-1]^3=(t-2)^3-(t-2)^3+3(t-2)^2-3(t-2)+1$$
$$=3(t-2)^2-3(t-2)+1$$
$$\ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots$$
$$(2)^3-(1)^3=(2)^3-[2-1]^3=(2)^3-(2)^3+3(2)^2-3(2)+1$$
$$=3(2)^2-3(2)+1$$
$$(1)^3-(0)^3=(1)^3-[1-1]^3=(1)^3-(1)^3+3(1)^2-3(1)+1$$
$$=3(1)^2-3(1)+1.$$

Summing:

$$t^3=3S_2-3S_1+t$$
$$3S_2=t^3-t+3S_1;\ S_1=\frac{t(t+1)}{2}$$
$$3S_2=t^3-t+3\left[\frac{t(t+1)}{2}\right]$$
$$=t\left[t^2-1+3\left(\frac{t+1}{2}\right)\right]$$
$$=t(t+1)\left(t-1+\frac{3}{2}\right)$$
$$=\frac{t(t+1)\ (2t+1)}{2}$$
$$S_2=\frac{t(t+1)\ (2t+1)}{6}.$$

The formulae for the summations of the higher powers and for the powers of the first t *odd* natural numbers are found by similar procedure.

$$S_1=\frac{t(t+1)}{2}=\frac{t^2+t}{2}$$

$$S_2=\frac{t(t+1)(2t+1)}{6}=\frac{2t^3+3t^2+t}{6}=(S_1)\left(\frac{2t+1}{3}\right)$$

$$S_3=\left[\frac{t(t+1)}{2}\right]^2=\frac{t^4+2t^3+t^2}{4}=(S_1)^2$$

$$S_4=\left[\frac{t(t+1)(2t+1)}{6}\right]\left[\frac{3t^2+3t-1}{5}\right]=\frac{6t^5+15t^4+10t^3-t}{30}$$

$$=(S_2)\left(\frac{3t^2+3t-1}{5}\right)$$

$$S_5=\left[\frac{t(t+1)}{2}\right]^2\left[\frac{2t^2+2t-1}{3}\right]=\frac{2t^6+6t^5+5t^4-t^2}{12}=(S_3)\left(\frac{2t^2+2t-1}{3}\right)$$

$$=(S_1)^2\left(\frac{2t^2+2t-1}{3}\right)$$

SUMMATIONS OF POWERS OF THE ODD NATURAL NUMBERS

t	$_oS_1$	$_oS_2$	$_oS_3$	$_oS_4$	$_oS_5$	$_oS_6$	t
1	1	1	1	1	1	1	1
2	4	10	28	82	244	730	2
3	9	35	153	707	3,369	16,355	3
4	16	84	496	3,108	20,176	134,004	4
5	25	165	1,225	9,669	79,225	665,445	5
6	36	286	2,556	24,310	240,276	2,437,006	6
7	49	455	4,753	52,871	611,569	7,383,815	7
8	64	680	8,128	103,496	1,370,944	18,654,440	8
9	81	969	13,041	187,017	2,790,801	42,792,009	9
10	100	1,330	19,900	317,338	5,266,900	89,637,690	10
11	121	1,771	29,161	511,819	9,361,001	175,604,011	11
12	144	2,300	41,328	781,660	15,787,344	323,839,900	12
13	169	2,925	56,953	1,163,385	25,553,969	567,780,525	13
14	196	3,654	76,636	1,713,736	39,901,876	955,201,014	14
15	225	4,495	101,025	2,471,007	60,413,025	1,550,034,335	15
16	256	5,456	130,816	3,544,538	89,043,176	2,437,538,016	16
17	289	6,545	166,753	4,930,449	128,177,569	3,728,995,985	17
18	324	7,770	209,628	6,031,074	180,599,444	5,567,361,610	18
19	361	9,139	260,281	7,905,235	250,043,401	8,132,988,019	19
20	400	10,660	319,600	10,318,676	340,267,600	11,851,731,780	20
21	441	12,341	388,521	13,044,437	456,123,801	16,401,836,031	21
22	484	14,190	468,038	16,463,238	603,132,244	22,723,199,070	22
23	529	16,215	559,153	20,563,863	787,680,369	31,036,964,695	23
24	576	18,424	662,976	25,443,544	1,017,005,376	41,806,180,224	24
25	625	20,825	780,625	31,208,345	1,299,480,625	55,647,467,225	25
26	676	23,426	913,276	37,973,546	1,644,505,876	73,243,755,026	26
27	729	26,235	1,063,153	45,864,027	2,063,701,369	95,408,116,155	27
28	784	29,260	1,228,528	55,014,652	2,565,985,744	123,088,756,960	28
29	841	32,509	1,413,721	65,570,653	3,167,677,801	157,385,204,029	29
30	900	35,990	1,619,100	77,688,014	3,882,602,100	199,888,737,670	30
31	961	39,711	1,846,081	91,533,855	4,727,198,401	251,088,112,031	31
32	1,024	43,680	2,096,128	107,288,816	5,719,634,944	313,609,614,240	32
33	1,089	47,905	2,370,753	125,137,441	6,879,925,569	389,028,504,865	33
34	1,156	52,394	2,671,516	145,288,562	8,230,050,676	479,486,887,034	34
35	1,225	57,155	3,000,025	167,956,683	9,794,082,025	587,405,080,115	35
36	1,296	62,196	3,357,936	193,367,364	11,598,311,376	715,505,334,036	36
37	1,369	67,525	3,746,953	221,765,606	13,671,382,969	866,839,560,325	37
38	1,444	73,150	4,168,828	253,406,230	16,044,439,844	1,044,818,075,950	38
39	1,521	79,079	4,625,361	288,559,371	18,751,214,001	1,253,240,456,039	39
40	1,600	85,320	5,118,400	327,509,352	21,828,270,400	1,496,327,911,560	40
41	1,681	91,881	5,649,841	370,556,073	25,315,054,801	1,778,757,448,041	41
42	1,764	98,770	6,221,628	418,014,394	29,254,095,444	2,105,697,831,410	42
43	1,849	105,995	6,835,753	470,215,019	33,691,148,569	2,482,847,337,035	43
44	1,936	113,564	7,494,256	527,504,780	38,675,357,776	2,916,473,536,044	44
45	2,025	121,485	8,199,225	590,247,021	44,259,417,225	3,413,454,839,005	45
46	2,116	129,766	8,952,796	658,821,982	50,499,738,676	3,981,334,081,046	46
47	2,209	138,415	9,757,153	733,637,183	57,456,622,369	4,628,314,384,495	47
48	2,304	147,440	10,614,528	815,077,808	65,194,431,744	5,363,406,155,120	48
49	2,401	156,849	11,527,201	903,607,069	73,781,772,001	6,196,378,180,049	49
50	2,500	166,650	12,497,500	999,666,890	83,291,672,500	7,137,858,309,450	50

t	$_0S_1$	$_0S_2$	$_0S_3$	$_0S_4$	$_0S_5$	$_0S_6$	t
51	2,601	176,851	13,527,801	1,103,727,091	93,801,773,001	8,199,378,460,051	51
52	2,704	187,460	14,630,528	1,216,277,972	105,394,513,744	9,393,430,756,580	52
53	2,809	198,485	15,778,153	1,337,638,597	118,157,329,369	10,733,528,397,205	53
54	2,916	209,934	17,003,196	1,468,908,198	132,182,846,676	12,234,256,749,054	54
55	3,025	221,815	18,288,225	1,610,066,359	147,569,066,235	13,911,358,859,895	55
56	3,136	234,136	19,665,856	1,761,873,400	164,419,667,776	15,781,771,412,056	56
57	3,249	246,905	21,108,753	1,924,920,761	182,844,019,569	17,863,723,164,685	57
58	3,364	260,130	22,629,628	2,099,821,386	202,957,591,444	20,176,783,930,290	58
59	3,481	273,819	24,231,241	2,287,210,107	224,882,071,801	22,741,948,132,059	59
60	3,600	287,980	25,916,400	2,487,744,038	248,745,608,400	25,581,708,987,340	60
61	3,721	302,631	27,687,961	2,702,102,909	274,683,033,001	28,730,137,364,081	61
62	3,844	317,750	29,548,838	2,930,989,550	302,836,089,844	32,182,963,355,750	62
63	3,969	333,375	31,501,953	3,175,130,175	333,353,667,969	35,997,660,621,375	63
64	4,096	349,504	33,550,336	3,435,274,816	366,392,037,376	40,193,533,536,064	64
65	4,225	366,145	35,697,025	3,712,197,697	402,115,089,025	44,801,807,198,785	65
66	4,356	383,306	37,945,116	4,006,697,618	440,694,578,676	49,855,720,343,066	66
67	4,489	400,995	40,297,753	4,319,598,339	482,310,374,569	55,390,621,196,835	67
68	4,624	419,220	42,758,128	4,651,748,964	527,150,708,944	61,444,066,337,460	68
69	4,761	437,989	45,329,481	5,004,024,325	575,412,433,401	68,055,922,588,089	69
70	4,900	457,310	48,015,100	5,377,325,386	627,301,378,100	75,268,472,001,230	70
71	5,041	477,191	50,818,321	5,772,579,527	683,032,114,801	83,126,519,976,071	71
72	5,184	497,640	53,743,528	6,190,741,128	742,829,223,744	91,677,506,554,920	72
73	5,329	518,665	56,791,153	6,632,791,753	806,926,564,369	100,971,620,945,545	73
74	5,476	540,274	59,967,676	7,099,740,634	875,568,049,876	111,061,919,315,074	74
75	5,625	562,475	63,275,625	7,592,625,035	949,007,825,625	122,004,445,901,675	75
76	5,776	585,276	66,718,576	8,112,510,636	1,027,510,551,376	133,858,357,490,076	76
77	5,929	608,685	70,300,153	8,660,491,917	1,111,351,687,369	146,686,061,297,005	77
78	6,084	632,710	74,024,028	9,237,692,542	1,200,817,784,244	160,553,296,312,630	78
79	6,241	657,359	77,893,921	9,845,265,743	1,296,206,776,801	175,529,368,144,079	79
80	6,400	682,640	81,913,600	10,484,384,704	1,397,828,281,600	191,687,187,407,120	80
81	6,561	708,561	86,088,881	11,156,293,945	1,506,003,898,401	209,103,461,712,081	81
82	6,724	735,130	90,417,528	11,862,304,706	1,621,087,515,444	227,858,531,990,090	82
83	6,889	762,355	94,909,753	12,603,405,331	1,743,365,618,569	248,038,018,306,715	83
84	7,056	790,244	99,567,216	13,381,201,952	1,873,257,604,176	269,730,979,902,084	84
85	7,225	818,805	104,394,025	14,196,932,373	2,011,116,096,025	293,038,066,024,565	85
86	7,396	848,046	109,394,236	15,051,968,454	2,157,327,265,876	318,030,175,069,086	86
87	7,569	877,975	114,571,953	15,947,713,495	2,312,291,157,969	344,838,938,401,175	87
88	7,744	908,600	119,931,328	16,885,604,120	2,476,422,017,344	373,561,839,791,600	88
89	7,921	939,929	125,476,561	17,867,110,361	2,650,148,633,001	404,311,437,816,089	89
90	8,100	971,970	131,211,900	18,893,736,042	2,833,914,618,900	437,206,551,261,010	90
91	8,281	1,004,731	137,141,641	19,967,019,163	3,028,179,863,801	472,367,379,588,091	91
92	8,464	1,038,230	143,270,138	21,088,533,284	3,233,415,764,944	509,925,732,497,360	92
93	8,649	1,072,445	149,601,753	22,259,883,909	3,450,115,630,569	550,015,207,637,885	93
94	8,836	1,107,414	156,140,956	23,482,713,870	3,678,785,030,376	592,776,383,513,094	94
95	9,025	1,143,135	162,893,225	24,758,703,711	3,919,947,100,225	638,356,016,633,455	95
96	9,216	1,179,616	169,860,096	26,089,567,072	4,174,142,002,176	686,907,242,896,096	96
97	9,409	1,216,865	177,049,153	27,477,055,073	4,441,927,186,369	738,589,783,445,345	97
98	9,604	1,254,890	184,464,028	28,922,955,698	4,723,877,808,244	793,570,154,710,970	98
99	9,801	1,293,699	192,109,401	30,429,094,179	5,020,587,089,001	853,021,883,020,069	99
100	10,000	1,333,300	199,990,000	31,997,333,380	5,332,666,690,000	914,125,723,616,900	100

$$S_6=\left[\frac{t(t+1)(2t+1)}{6}\right]\left[\frac{3t^4+6t^3-3t+1}{7}\right]=\frac{6t^7+21t^6+21t^5-7t^3+t}{42}$$
$$=(S_2)\left(\frac{3t^4+6t^3-3t+1}{7}\right).$$

If t denotes the number of terms in the series $1, 3, 5, 7 \ldots (2t-1)$; and if $_0S_1$, $_0S_2$, $_0S_3$, $_0S_4$, $_0S_5$ and $_0S_6$ denote the sums of the first, second, third, fourth, fifth and sixth powers of these numbers, then it can be shown that:

$$_0S_1=t^2$$

$$_0S_2=\frac{t(2t-1)\ (2t+1)}{3}=\frac{4t^3-t}{3}$$

$$_0S_3=t^2(2t^2-1)=2t^4-t^2=(_0S_1)(2t^2-1)$$

$$_0S_4=\left[\frac{t(2t-1)(2t+1)}{3}\right]\left[\frac{12t^2-7}{5}\right]=\frac{48t^5-40t^3+7t}{15}=(_0S_2)\left(\frac{12t^2-7}{5}\right)$$

$$_0S_5=\frac{t^2}{3}(16t^4-20t^2+7)=\frac{16t^6-20t^4+7t^2}{3}=(_0S_1)\left(\frac{16t^4-20t^2+7}{3}\right)$$

$$_0S_6=\left[\frac{t(2t-1)(2t+1)}{3}\right]\left[\frac{48t^4-72t^2+31}{7}\right]=\frac{192t^7-336t^5+196t^3-31t}{21}$$

$$=(_0S_2)\left(\frac{48t^4-72t^2+31}{7}\right).$$

Further, if, in fitting a secular trend, the mean of time be taken midway in the time series, if the number of time points is odd and is denoted by n and deviations from the means by x, and since $t=\frac{n-1}{2}$, it can be demonstrated that:

$$\Sigma x=0$$

$$\Sigma x^2=\frac{n(n-1)(n+1)}{12}=\frac{n^3-n}{12}$$

$$\Sigma x^3=0$$

$$\Sigma x^4=\left[\frac{n(n-1)(n+1)}{12}\right]\left[\frac{3n^2-7}{20}\right]=(\Sigma x^2)\left(\frac{3n^2-7}{20}\right)$$

$$\Sigma x^5=0$$

$$\Sigma x^6=\left[\frac{n(n-1)(n+1)}{12}\right]\left[\frac{3n^4-18n^2+31}{112}\right]=(\Sigma x^2)\left(\frac{3n^4-18n^2+31}{112}\right)$$

where x is one time unit.

Similarly, if the number of time points is even, and since $t=\frac{n}{2}$, it can be proved that:

$$\Sigma x=0$$

$$\Sigma x^2=\frac{n(n-1)(n+1)}{3}$$

$$\Sigma x^3=0$$

$$\Sigma x^4=\left[\frac{n(n-1)(n+1)}{3}\right]\left[\frac{3n^2-7}{5}\right]=(\Sigma x^2)\left(\frac{3n^2-7}{5}\right)$$

$$\Sigma x^5=0$$

$$\Sigma x^6=\left[\frac{n(n-1)(n+1)}{3}\right]\left[\frac{3n^4-18n^2+31}{7}\right]=(\Sigma x^4)\left(\frac{3n^4-18n^2+31}{7}\right)$$

where x is one-half the time unit.

In applying these formulae a partial check on the results is that the answer must invariably be an integer.

It seems needless to repeat here the table already referred to of summations of the powers of the series 1, 2, 3, etc. Above is a similar table for the first four powers of the first one hundred *odd* integers, that is of the series 1, 3, 5, 7, . . . 199.

POPULATION STATISTICS OF FOREIGN COUNTRIES

By Edgar Sydenstricker

The preliminary results of an inquiry on the number of inhabitants of the different countries and the various methods of making inter-censal estimates of population may be of interest to members of the Association.

They are doubtless familiar with the very complete and exceedingly useful demographic data compiled by the International Institute of Statistics under the able supervision of that indefatigable statistician, M. Methorst, the Secretary-General of the Institute. The special inquiry to which reference is made here supplements his work in certain respects, particularly on the methods for arriving at inter-censal estimates. This study was made by my valued colleague, Mr. A. Loveday, Chief of the Statistical Service of the Economic Section in the League of Nation's Secretariat, at my suggestion last year when I was temporarily in charge of the Statistical Service of the Health Section in the same organization. Since both statistical services needed the information for immediate purposes, we determined upon a very simple inquiry as a beginning which included the following items for each country:

(1) The area.

(2) The population (a) as enumerated in the last census and (b) as of the latest estimate.

(3) The periodicity and date of census.

(4) Official estimate of nationals temporarily abroad on date of census.

(5) Frequency of inter-censal estimates and methods employed in making such estimates, together with the system adopted for rectifying the results of estimates and adjusting them to subsequent census results.

When replies were received from 29 countries it was thought advisable to present the preliminary results. A statement was prepared by Mr. Loveday and was published;[1] a more complete summary will be published when more replies are received. Furthermore, in planning various details of the work of the Statistical Service in the Health Section, I had in mind the collection, in coöperation with the official statisticians of the different countries and with members of the Inter-

[1] *Monthly Bulletin of Statistics*, League of Nations. Geneva, July 24 (Vol. 5, No. 7), pp. 3-9.

national Institute of Statistics, more detailed data on the sex, age, race and other factors in the composition of the various populations as a necessary basis for computing specific mortality and other rates as well as the foundation for a scientific consideration of a satisfactory "standard" in adjustments for these factors. In fact, the League's Health Committee early in 1924 adopted the recommendation for the appointment of a committee on the latter question and a committee, headed by Professor Alfredo Nicefaro, of the University of Naples has already begun work.

The preliminary information on area and population as compiled by Mr. Loveday is summarized in the accompanying tables.

It appears that there is no uniform census date and that information concerning the day to which the census refers was not in all cases supplied by the countries replying. The report says: "In some countries the day for the enumeration has been changed on the ground that at certain periods of the year many people are likely to be away from home, or for other practical reasons. Thus for instance, in India, the censuses of 1911 and of 1921 were taken respectively on the night of the 10th of March and of the 18th of March. The chief considerations which determined the selection of these dates are, as appears from the Census Reports of India: (a) that the date should be as nearly the exact decennial anniversary of the previous census as possible; (b) that there should be moonlight between 7 P. M. and midnight when enumerators make their verification of the schedules, and (c) that occasions of large fairs or other gatherings which would disturb the normal distribution of the population should be avoided. The dates regarded as auspicious for marriages or for bathing in the sacred rivers should also be avoided. In Switzerland and in Norway the census is taken on December 1; in Germany, before the war, the census was taken as 1st or 2nd day of December. The last day of the year has been chosen by Austria (except for the last census), Hungary, Bulgaria, Sweden and the Netherlands; for this last country the first general census of 1830 was made on January 1st of that year; the census of 1840 also on January 1; that of 1849, on November 19; that of 1859 on December 31; that of 1869 on December 1; those of 1879, 1889, 1899, 1909 and 1920 on December 31. In future the census date will be December 31. In the United States of America the census date in 1900 and 1890 and in the previous censuses back to 1830 was June 1; in 1910, April 15; in 1920, January 1. The first day of the year is also chosen in Greece; in Denmark February 1; in France the beginning of March. In Egypt and in New Zealand the census is taken during March or April; in the Union of South Africa during the beginning of May; in Canada on June

1; in England, Scotland and Wales the last census was taken as for midnight 19th of June. In Italy the censuses of 1861, 1871, and 1881 were taken on December 31, the census of 1901 on February 10, that of 1911 on June 10 and the last of 1921 on December 1." In the table will be found the exact dates, in so far as information is available, on which the last census in each country was taken.

On the question of the estimated number of nationals temporarily abroad on the date of the last census, only a few countries supplied information, as follows:

Japan	193,000 in 1921	
Italy	932,393 in 1921	
Greece	208,367 in 1921	
Sweden	25,074 in 1920	(excluding occasional travelers)
Norway	17,033 in 1920	
Japan	585,183 in 1920	

The various methods employed in making inter-censal estimates are of especial interest since so little information on the subject has been collected. It is pointed out that three methods are generally adopted, namely:

(1) The use of records of births, deaths, and migration.

(2) Calculation of increase upon the principle of arithmetic progression.

(3) Calculation of increase upon the principle of geometric progression.

The first method obviously is confined to those countries which have a system of local registration of residents or fairly accurate records of migration in addition to registration of births and deaths, namely: Germany, Austria, Belgium, Denmark, Esthonia, Finland, Hungary, Italy, Lithuania, Norway, Netherlands, Poland, Roumania, United Kingdom, Sweden, Switzerland, Czechoslovakia, Guatemala and New Zealand.

The methods of inter-censal estimates and of rectifying the results in England and Wales and in certain other countries, are summarized so succintly in Mr. Loveday's report that I quote:

"In England and Wales inter-censal estimates of the population are derived from the preceding census of population by the addition of the births and immigrants and the deduction of deaths and emigrants of the intervening period. The records of births and deaths are practically exact; the migration estimates are obtained from the records obtained from shipping offices and ports which differentiate between temporary visitors and passengers permanently changing their country of residence. Movement between the several countries of the United

Kingdom is not known, but is regarded as comparatively small and the estimated population in 1921 differed from the census figure of that date by the insignificant fraction of about 2 per 1,000. In these circumstances it was sufficient to adjust the previous estimates on the assumption that the error had grown continuously throughout the decennium.

"The same procedure is adopted successfully in Sweden, Denmark, Norway, the Netherlands and Italy. In Scotland, where the same method is in force, the error was so small, in 1921, the first date for which the system could be tested, that no adjustment was made in the estimates. In Sweden the estimates have proved to be so accurate, that no correction has had to be made, except for the years 1916–1919 in respect of the population by age groups. In Denmark the figures of departures are known, but the figures of the arrivals are obtained by assuming that the average annual increase from the immigration during the preceding inter-censal period, will continue unchanged during the current period. In Finland since 1920 the migration returns have been accurately kept, but they are less complete with regard to returning emigrants. In Norway the results of the annual estimates are adjusted to the results of the census by distributing pro rata the difference between the result of the last census and the population estimated for the same year through the nine years preceding the census. In the Netherlands and in Austria, interpolation is employed, when necessary, to revise the estimates of the preceding years, the population at the last census being known.

"In Italy two systems have been adopted for rectifying the results of annual estimates and adjusting them to the results of the last census. Up to the end of 1901 estimates were calculated from the arithmetical increase between the two last censuses, on the assumption that the same annual increase continues each year. But after 1901, as the emigration increased considerably, it was decided to ascertain the changes in migration on the basis of the municipal registers of population. If the estimate of the population of one given district is found to be too high or too low in comparison with the census, the discrepancies are distributed pro rata through the years of the inter-censal period and are assumed to be in proportion to the total migration of that district. In those districts where underestimates are found, the correction is made by increasing yearly pro rata the figures of the registered increase of population or diminishing the registered decrease. In the other districts the overestimates are corrected by decreasing the registered excess of population and increasing the registered decrease of population arising from emigration.

"The method adopted in Germany is explained as follows: Until July 1, 1914, the yearly estimate of the population was made by adding to the actual resident population at the last census the excess of births over deaths, and deducting the registered oversea emigration. Moreover, account was taken of the accessions and losses from non-supervised emigration; this factor was calculated on the assumption that the mean yearly accession or loss from non-supervised emigration registered between two previous census years would continue unchanged. This mean was calculated from the results of the two last censuses and also from the registered excess of births over deaths and from the registered oversea emigration of the inter-censal period. The number of inhabitants obtained in this manner was at times corrected up to the year 1910, according to the results of the last census; that is, the provisional figures of the non-supervised emigration were replaced by the figures of the actual registered migration for the inter-censal period, and these distributed pro rata uniformly through the five years preceding the census.

"Since the last census on October 8, 1919, the estimates of the population are based only on the statistics of births, deaths and oversea emigration (including the war prisoners outside the territory of the Reich, estimated at the census date at about 400,000). A general statistic of migrations is not available and the results of the estimates are not very reliable, because they make no allowance for the immigrants entered in the territory of the Reich since the last census which may number approximately $1\frac{1}{4}$–$1\frac{1}{2}$ millions.

"In Poland the estimate is based on the natural increase of the population; that is, on the excess of births over deaths since the last census, taking into account the disturbing factors due to emigration, reëmigration, repatriation and changed boundaries. No accurate information on the growth of population being available, the natural increase has also been calculated by comparison with other European countries in the same years 1921–1923. In Switzerland the yearly estimate of the population is based also on the natural increase of the population, taking into account the results of the yearly censuses which are taken in certain cantons and in certain towns. In Belgium the inter-censal estimations are not brought into line with the census results, but the latter, when known, simply substituted for the former. In Guatemala the results of the estimate differ from those of census not only owing to defective migration statistics, but also to the large number of non-registered deaths. In New Zealand compulsory registration of births and deaths dates from 1855 and is believed to be remarkably complete. Statistics of arrivals and departures are

compiled from individual declarations made by or on behalf of each passenger arriving or departing and from statements of the numbers of crews, etc."

The method of computing the increment in population upon the principle of arithmetic progression is used in the United States, Canada and the Union of South Africa. In Canada, however, the method is somewhat different from that employed in the United States,[1] and is described as follows:

"In Canada a yearly ratio for the Dominion as a whole is based upon the increase between the two previous censuses. This Dominion estimate was distributed among the provinces by first adding to the 1921 population of each province one-tenth of the arithmetic increase in that of the whole Dominion obtained by geometric progression divided by the population of the whole Dominion by arithmetic progression.[2]"

In the Union of South Africa, records of migration of Europeans are utilized in checking the results and a certain allowance is made for the mortality caused by the influenza epidemic in 1918.

The principle of geometric progression is employed in Bulgaria, Greece, in the Kingdom of the Serbs, Croats and Slovenes, and in Egypt. In Bulgaria the estimated population at the beginning of 1913, instead of the enumerated population as of 1911, and the census of 1921 are used as the two points. In Greece allowance is made for territorial changes made by the Treaty of Lausanne, and 1,250,000 refugees from Asia Minor have been added. In Egypt no allowance for migration is made because it is considered unimportant. Inter-censal estimates are not made regularly in France or India. In India the geometric progression method is used when occasion arises for estimating the population exclusive of the Indian States.

While an absence of uniformity in the methods used in making inter-censal estimates is quite apparent, the differences in applying any given method are also extremely important. These differences are barely suggested in the brief preliminary report. Since the whole question is one of statistical procedure and administrative practice for which the official statisticians in most of the countries are directly responsible, it may be hoped that, after a careful study of the subject and of the situation is made, some agreements in procedure may be developed.

[1] As is well known, in the case of localities where unusual conditions prevail or occur, the Vital Statistics Division of the United States Bureau of the Census utilizes other available information than the census enumeration for making inter-censal estimates.

[2] The Dominion Bureau of Statistics of Canada remarks that "this is admittedly a rough method and the results are used as sparingly as possible. Greater refinement of calculation is considered inadvisable owing to the fact that, with the knowledge that a large emigration is going on, we have no statistics on this emigration. For per capita calculations this method is probably little better than the last census figures."

POPULATION DATA FOR VARIOUS COUNTRIES[1]

(Rearranged from monthly Bulletin of Statistics, League of Nations, July, 1924, pp. 10–11)

Country	Pre-war		Post-war			
			Last census		Latest estimate	
	Date of Enumeration	Number of inhabitants ***	Date of Enumeration	Number of inhabitants ***	Date: as of—	Number of inhabitants ***
Europe						
Albania	....	....	....	....	1923	832
†Austria	Dec. 31, 1910**	28,572	Mar. 7, 1923	6,537	....	....
†Belgium (b)	" " " **	7,416	Dec. 31, 1920	7,466	Dec. 31, 1922	7,599
†Bulgaria	" " 1911* (c)	4,401	" " "	(d) 4,861	Jan. 1, 1924	5,008
†Czechoslovakia	1910* (n)	13,594	Feb. 15, 1921	13,613	" 1, 1923	13,855
Danzig	....	....	Nov. 1, 1923	(d) 364	....	....
†Denmark	Feb. 1, 1911**	2,775	Feb. 1, 1921	3,268	July 1, 1923	3,352
†Esthonia	....	....	Dec. 28, 1922	1,107	....	....
†Finland	Dec. 31, 1910**	3,115	Dec. 31, 1920	3,148	Dec. 31, 1922	3,435
†France	Mar. 5, 1911**	39,192	Mar. 6, 1921	39,209	"	....
†Germany	Dec. 1, 1910**	64,926	Oct. 8, 1919	59,853	Jan. 1, 1924	62,607
†Greece	1913* (c)	4,810	Jan. 1, 1921	(f) 5,536	" " "	6,435
†Hungary	Dec. 31, 1910**	20,886	Dec. 31, 1920	7,980	Dec. 31, 1923	38,156
†Italy	June 10, 1911**	34,671	" 1, 1921	38,711	" " "	39,612
†Latvia	Jan. 1, 1914**	2,552	....	....	Jan. 1, 1923	1,886
†Lithuania (h)	....	....	Sept. 17, 1923	2,169	" 1, 1924	2,175
†Luxemburg	Dec. 1, 1916**	264	Dec. 1, 1922	261	....	....
†Netherlands	" 31, 1909**	5,858	Dec. 31, 1920	6,865	Dec. 31, 1923	7,213
†Norway	" 1, 1910**	2,358	" 1, "	2,632	" " "	2,713
†Poland (i)	....	....	Sept. 30, 1921	27,193	Jan. 1, 1924	28,478
Portugal (j)	Feb. 1, 1911**	5,958	Dec. 1, 1920	6,033	....	....
†Roumania	Jan. 1, 1913** (c)	7,897	—	—	Jan. 1, 1924	16,750
Russia (l)	1914*	135,599	Aug. 28, 1920	131,299	....	....
†Serbs, Croats and Slovenes	....	....	Jan. 31, 1921	12,017	Jan. 31, 1924	12,492
Spain	Dec. 31, 1910**	19,951	Dec. 31, 1920	21,338	June 30, 1923	21,640
†Sweden	" " " **	5,522	" " "	5,904	Dec. 31, 1923	6,006
†Switzerland	" 1, " **	3,765	" 1, "	3,886	1923 (m)	3,902
Turkey	1913* (a)	1,891	....	....	....	....
†United Kingdom	Apr. 2, 1911**	45,222	June 19/20, 1921	47,262	June 30, 1923 (v)	(43,582)
North and Central America						
†Canada	June 1, 1911**	7,207	June 1, 1921	8,788	June 1, 1923	9,146
Costa Rica	Dec. 31, 1913*	411	—	—	Dec. 31, 1922	485
Cuba	Oct. 30, 1907**	2,049	Sept. 15, 1919	2,889	" " "	3,123
†Guatemala	1910*	1,992	Aug. 28, 1921	2,005	....	....
Haiti	1912* (a)	2,500	Sept. —. 1919	1,631	Jan. 1, 1923	2,045
Honduras	Dec. 31, 1910*	553	....	....	" " "	673
Mexico	Oct. 27, 1910**	15,160	1921	14,210	....	....
Nicaragua	1910* (a)	600	Jan. 1, 1920	638	....	....
Panama	1911*	337	1920	401	....	....
Salvador	1912*	1,161	....	....	Jan. 1, 1922	1,526
†United States (o)	Apr. 15, 1910**	91,972	Jan. 1, 1920	105,711	July 1, 1923	110,664
South America						
Argentina	June 1, 1914**	7,885	—	—	Dec. 31, 1923	9,556
Bolivia	1915*	2,890	....	....	1919 (a)	2,500
Brazil	1912*	24,618	Sept. 1, 1920	30,636	....	....
Chile	1907**	3,249	1920	3,754	Jan. 1, 1923	3,831
Colombia	1912**	5,069	Oct. 14, 1918	5,847	....	....
Ecuador	1908*	1,329	....	....	1922 (a)	2,000
Paraguay	1910* (a)	900	....	....	1918 (a)	1,000
Peru	1908* (a)	4,500	....	....	1919 (a)	7,300
Uruguay	1913*	1,279	....	....	Dec. 31, 1923	1,603
Venezuela	Jan. 1, 1913*	2,756	....	....	" " 1920	2,412

[1] For footnotes see page 87.

POPULATION DATA FOR VARIOUS COUNTRIES (*Continued*)

Country	Pre-war		Post-war			
			Last census		Latest estimate	
	Date of Enumeration	Number of inhabitants ***	Date of Enumeration	Number of inhabitants ***	Date: as of—	Number of inhabitants ***
Asia						
China (p)	....	....	....	....	1922	443,428
†India	1911**	315,156	1921	318,942	....	....
†Japan	1913**	53,633	Oct. 1, 1920	55,963	Sept. 1, 1923	58,482
† " Colonies (Chosen,	....	....	" " "	21,025	Oct. 1, 1922	21,815
Taivan, Karafuto)	....	....	....	....	....	....
Palestine	....	....	Oct. 23, 1923	757	....	....
Persia	....	....	....	....	1922 (a)	10,000
Siam	1914*	8,449	....	....	1923	9,332
Africa						
†Egypt	1907**	11,287	Mar. 7, 1917	12,751	Dec. 31, 1923	13,717
Liberia	....	....	....	....	1921 (a)	1,500
†Union of South Africa	May 7, 1911**	5,973	May 3, 1921	6,929	June 30, 1924	7,294
Oceania						
Australia	Dec. 31, 1913*	(r) 4,894	Apr. 4, 1921	(r) 5,436	Mar. 31, 1924	(r) 5,777
†New Zealand	Apr. —, 1911**	(t) 1,008	" 17, "	(s) 1,322	" " "	1,394

† Direct official communications.
* Estimate.
** Census.
*** 000 omitted.
(a) Approximate figure.
(b) "De jure" population.
(c) According to the frontiers fixed by the Treaty of Bukarest (1913).
(d) Preliminary figures.
(f) According to the frontiers fixed by the treaty of Sevres (1920) (sq. km. 147. 634).
(h) Including Klaipeda (Memel).
(i) Including the parts of Vilno district and Upper Silesia transferred to Poland.
(j) Including the Açores and Madeira.
(l) Including Asiatic territory.
(m) Mean population, for year.
(n) The figure for the pre-war population refers to all the territories of which the Czechoslovak Republic is at present composed.
(o) Continental United States only.
(p) Including Tibet and Mongolia.
(r) Excluding natives.
(s) Including mandated territories of Western Samoa.
(t) Figure referring to the Dominion proper (sq. km. 267. 503). Excluding Maoris, Cook and other Pacific islands.
(v) Great Britain only: England and Wales (sq. km. 151. 176). Estimate June 30, 1923: 38,403,000 inhabitants; Scotland (sq. km. 77. 169). Estimate June 30, 1923: 4,901,000; Northern Ireland (sq. km. 13. 565). Estimate June 30, 1923: 1,278,000.

AREA DATA FOR VARIOUS COUNTRIES[1]

(Rearranged from monthly Bulletin of Statistics, League of Nations, July, 1924, pp. 10–11)

Country	Area in square kilometers			
	Pre-war		Post-war	
Europe				
Albania		.....	(a)	45,000
† Austria		300,004		83,833
† Belgium		29,451		30,444
† Bulgaria	(c)	111,837		103,146
† Czechoslovakia		.....		140,394
Danzig		.....		1,914
† Denmark		40,432		43,017
† Esthonia		.....		47,549
† Finland		377,415		388,451
† France		536,464		550,986
† Germany		540,858		472,034
† Greece	(c)	119,050	(e)	140,135
† Hungary		325,411		92,916
† Italy		286,610	(g)	310,085
Latvia		.....		65,791
† Lithuania (h)		.....		56,257
Luxemburg		2,586		2,586
† Netherlands		34,201		34,201
† Norway		323,793		323,793
† Poland (i)		.....		388,328
Portugal (j)		91,943		91,943
† Roumania	(c)	139,078		294,244
Russia (l)		.....		20,894,656
† Serbs, Croats, Slovenes		.....		248,987
Spain		505,208		505,208
† Sweden		448,460		448,460
† Switzerland		41,295		41,295
Turkey	(a)	28,183		.....
† United Kingdom (k)		309,400		309,400
North and Central America				
† Canada		9,659,739		9,659,739
Costa Rica		59,585		59,585
Cuba		114,524		114,524
† Guatemala		109,724		109,724
Haiti		26,435		26,435
Honduras		119,819		119,819
Mexico		1,987,201		1,987,201
Nicaragua		127,461		127,461
Panama		83,886		83,886
Salvador		34,126		34,126
† United States (o)		7,839,308		7,839,308
South America				
Argentina		2,987,353		2,987,353
Bolivia	(a)	1,590,000	(a)	1,590,000
Brazil		8,485,284		8,485,284
Chile		752,024		752,024
Colombia		1,195,870		1,195,870
Ecuador		307,243		307,243
Paraguay	(a)	445,000	(a)	445,000
Peru		1,802,422		1,433,000
Uruguay		186,926		186,926
Venezuela		1,020,400		1,020,400
Asia				
China (p)		11,138,900		11,138,900
† India		4,675,000		4,675,000
† Japan		385,522		385,522
† " Colonies (Chosen, Taivan, Karafuto)		292,800		292,800
Palestine		.....		23,000
Persia		1,626,943		1,626,943
Siam		503,957		503,957

[1]For footnotes see page 89.

AREA DATA FOR VARIOUS COUNTRIES (*Continued*)

Country	Area in square kilometers	
	Pre-war	Post-war
Africa		
† Egypt	(q) 1,000,000	(q) 1,000,000
Liberia	(a) 95,400	(a) 95,400
† Union of South Africa	1,223,367	1,223,367
Oceania		
Australia	7,704,090	7,704,090
† New Zealand	268,997	(s) 272,261

† Direct official communications.
(a) Approximate figure.
(c) According to the frontiers fixed by the Treaty of Bukarest (1913).
(e) 1st January 1924.
(g) Excluding Fiume.
(h) Including Klaipeda (Memel).
(i) Including the parts of Vilno district and Upper Silesia transferred to Poland.
(j) Including the Açores and Madeira.
(k) The figure for the area has been calculated at high tide and does not include inland waters.
(l) Including Asiatic territory.
(o) Continental United States only.
(p) Including Tibet and Mongolia.
(q) Habitable area sq. km. 35. 362.
(s) Including mandated territories of Western Samoa.

THE CANADIAN PLAN OF ORGANIZATION OF GOVERNMENT STATISTICS[1]

The Canadian plan of statistical organization is that of centralization. In 1918 the Dominion Bureau of Statistics was created (under the "Statistics Act") and made responsible for the statistics "relative to the commercial, industrial, social, economic and general activities and conditions of the people"—practically a universal mandate. It was recognized that certain statistics must originate in, or can best be collected through, particular departments,—or in fact can best be interpreted and issued by such departments. To meet this situation and to insure that statistics serve departmental requirements as well as those of general policy, the Act enjoined collaboration between the Bureau and the several departments, under the following machinery: First, the Dominion Statistician, as chief of the Bureau, has standing access to heads of departments for conference purposes. Secondly, he is under instruction, on any point of statistical procedure involving departmental interests, to submit a *modus vivendi* between the Bureau and the department in question for the consideration of the Cabinet. Such recommendation, on approval, constitutes a permanent arrangement governing the particular subject. Thus, should dispute arise, it is settled by the body representative of all interests, especially those involving interdepartmental relations. In the working out, most of the purely statistical operations of the government have been brought under the immediate direction of the Bureau of Statistics, whilst the rest are governed by a series of specific agreements arrived at by the process indicated.

In Canada, as in the United States, government is on a federal basis, and several highly important functions are exercised by the Provinces. Coöperation accordingly must be worked out between the Bureau of Statistics and Provincial departments. Provision for this is made in a special clause of the Statistics Act which permits provincial officers to act as agents of the Bureau, and also gives the Bureau access to provincial records.

The work that has been organized to date under the Bureau of Statistics covers: (1) Demography, including (a) The Census, (b) Vital Statistics, and (c) Statistics of Migration; (2) Social Statistics, *e. g.*, criminology, education; (3) Production Statistics, including (a) agriculture, (b) fisheries, (c) forestry, (d) mining and metallurgy, (e) water powers and central electric stations, (f) general manufactures, and (g) construction; (4) External Trade—imports and exports; (5) Internal Trade—marketing of grain, live stock, animal products, etc.—cold storage,—prices, wholesale and retail; (6) Transportation and Communications—railways, tramways, express companies, shipping, telegraphs, telephones; (7) Finance—Dominion, Provincial and Municipal—currency, banking, interest, exchange, security prices, etc.; (8) General—The Year Book of Canada, Barometrics.

The purposes of statistical centralization include the economies in overhead, as

[1] Summary of paper presented at the meeting of the Committee on Governmental Labor Statistics of the American Statistical Association in Chicago, December 27, 1924.

in staff, equipment, library, administrative systems, etc., which organization usually permits. The convenience of the public is promoted through the reduction of questionnaires and the setting up of a central information agency. Statistical experience is concentrated and enhanced in value. The fundamental purpose, however, lies in the fact that the great subjects of statistics, such as production, trade, finance, population, are not separate and distinct, but are interrelated. Phenomena common to different fields must be treated in the same way throughout. The classification of commodities, for example, is made on the same principle, whether for production statistics, trade statistics, or price statistics; similarly with the classification of occupations, whether for the census, vital statistics, immigration statistics, or social statistics in general.

A concrete example of the manner in which this organization works out may be given. There are between three and four thousand factories making butter and cheese in Canada. Small individually, in the aggregate they constitute an important industry. They are under provincial jurisdiction, each Province having a Dairy Commissioner, whose staff inspects, instructs and generally supervises their operations. In addition there is a Dominion Dairy Commissioner, whose functions largely relate to interprovincial and export trade. Previous to 1918, most of these Provincial Dairy Branches collected and issued statistics. They did it by a variety of methods on such points as classification of products, fiscal year, etc. Hence, if a comparative view, or a Dominion total, were desired, the work had largely to be done over, or approximate results accepted. Subjects in which a Dairy Commissioner as such is apt not to be interested,—for example, the analysis of capital, labor conditions, fuel consumption, power equipment,—were for the most part omitted, so that if a Finance Department, Labor Department, Fuel Controller or Water Power authority desired to know the bearing of the dairying industry from their particular standpoints they had to find it out for themselves, incidentally duplicating overhead.

Under the present scheme the Bureau of Statistics, the Dominion Dairy Commissioner and the nine Provincial Dairy Commissioners have joined forces. A form for annual data has been agreed upon that will collect all the information that the several governments require. The Bureau prints and supplies this form, thus ensuring standardization. The duty of collection is assumed by the Provincial Departments; that of compilation and publication by the Bureau. The results as compiled are at once handed to the several Provinces, for use in any way they may think proper. The Bureau, however, undertakes to publish a report for the whole Dominion, which report is edited by the Dominion Dairy Commissioner. The data on labor, water power, fuel consumption, etc., are simultaneously made available to the departments interested. They are united, however, in the Bureau with similar materials similarly collected throughout the field of production.

In vital statistics, where the nine Canadian provinces once operated under nine distinctive acts, with nine different series of schedules for collecting the information, we have now agreed upon uniform methods, with collection by the provinces and compilation by the Bureau, the latter bringing out a Dominion report, prepared in consultation with the Federal Department of Health. There are, of

course, numerous subjects, which lie outside the possibility of arrangements of this kind. Here the Bureau works independently, though all such action is in principle complementary and supplementary.

A special word as to organization of labor statistics is in order. It goes without saying that such statistics should be carried out in the closest association with those of general social and economic conditions. First, all questions appertaining to labor conditions in the censuses of population and of industry are framed in consultation with the Department of Labor. The census is the great stock-taking of the nation, the background against which nearly all other statistics are projected. More specifically, the questions of the Census of Population dealing with occupations, earnings and unemployment, and the questions of the Industrial Census (annual) dealing with such points as the number and classification of employees, wages and salaries, hours of operations, etc., are thus discussed and their relative place in the general scheme determined. Secondly, those labor statistics which are collected by the method of continuous observation are the subject of special arrangement between the Labor Department and the Bureau. These include more particularly the statistics of strikes, the statistics of prices and cost of living, the statistics of wages, the statistics of employment and unemployment, and the statistics of industrial accidents.

The statistics of strikes are handled entirely in the Labor Department, a leading function of which in Canada may be described as the maintenance of industrial peace. In publication of these statistics, however, the Labor Department follows the Bureau's industrial classification and in general insures coördination on important points of method. On the subject of prices and cost of living, the Bureau of Statistics publishes the official monthly index number of wholesale prices. On retail prices, it also collects a series from selected dealers in towns of 10,000 or over; simultaneously the Department obtains a return from its representatives in the same towns; these two series are amalgamated and the Department analyzes the results and publishes them in the *Labor Gazette* (monthly), adding certain data as to rentals and generally covering the price situation from the cost of living standpoint. The Bureau publishes the annual official report on prices. Rates of wages are handled almost entirely in the Department of Labor. On the subject of employment statistics, the Bureau issues a monthly index number of employment based on returns received from employers of twenty hands and over throughout Canada. This is carried out in association with the Industrial Census. The Labor Department publishes these data in the *Labor Gazette*, with a return of unemployment which it collects monthly from trade unions and a statement of applications received and placements made by the Employment Service of Canada, which is administered by the Department.

As already stated the final objective of the Bureau of Statistics is the publishing of a national conspectus, of which two leading vehicles of expression exist. The first is the official Year Book of Canada. Here is utilized the complete scheme of coöperation between the Bureau and other Departments (over 40 in number) of which examples have been furnished, with the addition of such special studies as are essential to a well-rounded scheme. The second chief use of statistical synthesis is in the measurement and interpretation of the current eco-

nomic trend. The Bureau prepares the essential raw materials for this task, based on wide observation and experimentation, and maintains such analyses as enable it to act as advisor to the government, and in a limited way to the public.

No office of this kind, of course, can be conducted on a scale to meet all emergencies, but it can maintain a basic plan and organization capable of instant expansion, so that loss of time, duplication and confusion under an emergency may be avoided. And at the end of an emergency it can demobilize to advantage, retaining the essential and preserving the experience. It would be futile to say that only plain sailing is encountered in a program like that which has been outlined. Coöperation is always a disagreeable shibboleth; between departments, through the Cabinet, it is necessarily somewhat unwieldy and slow. The bringing together of expenditures upon statistics into a lump also unlooses criticism that is silent when the same are tucked away in the holes and corners of a budget; as a result, it is difficult to obtain recognition of the magnitude of the task and the need of the highest type of technical assistance. Difficulties like these, however, are calls to action and propaganda rather than to discouragement; they can be overcome by improved constitutional machinery and by the education of the people.

R. H. Coats
Dominion Statistician of Canada

COMMITTEE ON GOVERNMENTAL LABOR STATISTICS OF THE AMERICAN STATISTICAL ASSOCIATION

REPORT FOR 1924

The chief activities of the year have centered around the completion of a monograph on employment statistics, edited by Dr. Hurlin and Dr. Berridge, setting forth the standard practices recommended by the committee, and the general plan of organization for the collection of employment statistics by state and federal bureaus. After consultation with the secretary and editor of the American Statistical Association, the committee voted to ask the Russell Sage Foundation to publish this book as one of its series, indicating in the publication that it is the work of a committee of the American Statistical Association.

The annual report presented by the chairman to the American Statistical Association at its meeting in Washington, D. C., in December, 1923, dealt with the recommendations of the committee for the collection of employment statistics by the Federal Government, the kind and scope of data needed, the relationships between the bureaus responsible for the work, and the connection between the state governments and the federal governments in the collection of employment statistics. It may be well to sum up the developments of the past twelve months in the form of comments on the most important of these recommendations:

(1) *Initial responsibility upon the states.* In addition to New York, Wisconsin, Illinois, Massachusetts, and Maryland, which were collecting figures in accordance with the major recommendations of the committee when the last annual report

was made, their collection is now begun in Oklahoma, Oregon, and California, but only in California have arrangements been completed for coöperation with the Federal Bureau. It may be recalled from the last annual report that the Commissioner of Labor of Oklahoma asked our assistance in planning the collection of these figures, and we sent a representative of the committee, Professor Lescohier, to advise him. In California work has, also, been influenced by our committee and the standard plan adopted. In addition, we have assurance from Iowa, which now collects statistics of numbers employed only, that earnings statistics will be added, thus bringing Iowa into the plan. We have made tentative efforts to urge the collection of these figures in Ohio, because of its importance as an industrial state, and support has already been secured from several organizations representing both employers and labor.

Developments in the states in the collection of statistics of employment and earnings in the past year include:

(a) In Illinois, the development of chain relatives of employment by industries, with charts showing the course of employment in twelve of the principal industries. These have appeared in the Monthly Bulletin of the State Department of Labor since September. Chain relatives have also been developed showing the course of employment by sex in the metal industries.

(b) In Massachusetts, separation of data on employment by sex; addition of an item on the schedule, asking for "normal force"; a tentative experiment, for three months, in collecting data from building contractors, which is not yet regarded as conclusive enough for publication; and the publication of a report summarizing data for 1923 and 1924, using the average for 1922, taken from the census of manufactures, as a base, with charts for all industries grouped together, and for principal industries separately.

(c) In New York, special studies on various topics, such as labor shortage; factory wage rates; depression and recovery; earnings classified by sex; numbers employed, classified by sex. The schedule has been changed to provide for data classified by sex. Changes have been made in the industrial classification to facilitate comparison with similar data from other states and with the U. S. Census of Manufactures. Data are now given for industrial districts in which large cities are located. Data on employment since 1914 have been reviewed for these industrial districts. A series of studies has been undertaken to analyze seasonal employment by industries based on data collected in New York since 1914. The brick industry is the first, with others to follow. A beginning has been made in the collection of data on building permits, extended to include third-class cities, and classified into kinds of building, *e. g.* residential, industrial, etc.

(d) In Wisconsin, an experiment has been continued in collecting payroll data on employment in building, and comparative analysis of this information and that secured from building permits has led to the conclusion that payroll data are a more satisfactory measure of employment and that it is feasible to collect this information. Analyses have been made of the trends of employment in different industries including, besides manufactures, retail trade and farm labor, the last a three-year record for identical farms. Changes in employment by size of establishments have been studied in printing and publishing houses and machine shops

and factories. Wage rates have been analyzed in farm labor, public school teaching and the building trades for ten states in May, 1924. The course of employment in manufactures has been compared in Wisconsin, Illinois and New York. Other studies include methods of wage payment in selected industries, "persistency" of employes, as contrasted with labor turnover, in selected industries and labor turnover among child workers under 17, covering number of jobs and duration of jobs by industries.

In all the states experience is revealing the need for local data, not only for states but for industrial districts within the states.

(2) *The Federal Bureau of Labor Statistics as the coördinating center.* Coöperation is now in effect in six states, the state collecting and forwarding data to the Federal Bureau, which combines the figures with its own material from other states. The committee's recommendation, that the Bureau extend its employment statistics beyond manufacturing, notably to include the building trades, has not yet been acted upon, but an experiment is being tried by the Bureau in the District of Columbia and in Denver, Colorado, and if successful, it will be extended to the building trades elsewhere. The Geological Survey has not yet added questions regarding employment and earnings to its schedule of information. The Bureau of Labor Statistics is making a special study of employment in metalliferous mines and in coal mining with the expectation of collecting data monthly from both these branches of mining, and has already begun the work for coal mines. Summary figures for railroads furnished by the Interstate Commerce Commission are included in the monthly report made by the Bureau of Labor Statistics, but are much delayed.

(3) *Employment on the farms to be reported by the Department of Agriculture.* The Department of Agriculture is continuing its experiment, initiated a year ago to test the practicability of collecting monthly employment figures for farms in connection with data on wage rates. It has indicated that if the experiment succeed within reasonable cost, these figures will be continued and that a regular monthly report showing geographical differences will be published. The figures will, also, be made available in that event for inclusion in the report of the Bureau of Labor Statistics.

(4) *Publication of a National Bulletin of Employment by the Federal Bureau of Labor Statistics.* The Federal Bureau now publishes all its employment data in a special section of the *Monthly Labor Review.* News releases are sent out as promptly as the data are available. Recently, the Bureau has begun to publish as an advance bulletin, the portion of the employment section of the *Review* containing the payroll employment statistics collected by the Bureau. The bulletin covers now 8,500 manufacturing establishments in 52 industries, employing 2,500,000 wage earners whose total earnings during one week in November were $65,400,000. The recent extension of the Bureau's work on employment statistics is shown by comparison with its work in 1921, when only 700 establishments, employing 500,000 wage earners, in thirteen industries were covered. The greater part of the extension has come since July, 1922. It also includes the summary figures of the Interstate Commerce Commission on Class 1 railroads. Computing of a continuous monthly index of employment in manufacturing in-

dustries from June, 1914, and division of its summary figures for geographical districts are developments of the past year.

In the *Monthly Labor Review* are published summaries of the employment reports issued by several of the state bureaus collecting statistics, the report from the Geological Survey, and the main statistics of supply and demand in public employment offices in certain states. This more comprehensive report, however, is not as promptly available as the figures for manufacturing, as already indicated.

(5) *Publication of employment data for geographical subdivisions.* Until recently, the Bureau of Labor Statistics has published employment data for the entire country with no geographical classifications. The need of many business organizations, however, including the Federal Reserve Banks, is for information regarding geographical areas, particularly within the boundaries of the Federal Reserve Districts. Within the past year, the Bureau of Labor Statistics has begun publication of data for nine geographical divisions as above noted, adopting the census classification: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain and Pacific. No detailed figures by industries are yet given for these areas, however.

(6) *Elimination of duplicate collection of employment statistics.* The committee has taken the position that all duplication in the collection of statistics by state and federal bureaus can and should be avoided in the interests of economy and of the reporting employers, but duplication still exists. The United States Employment Service has recently terminated its collection of statistics for firms, which has duplicated that of the Bureau of Labor Statistics, but continues to publish statements about the general industrial situation. These tend to confuse the public mind particularly when they are not in agreement with the more accurate statements based on payroll data put out by the state and federal bureaus of labor statistics. As the U. S. Employment Service and the Bureau of Labor Statistics are both in the Department of Labor, it should surely be a simple administrative matter to assign to the Bureau exclusively the task undertaken by it ten years ago, of collecting data from firms. The Employment Service would still retain its own logical function of coördinating statistics from employment bureaus throughout the country showing demand and supply in calls registered in the bureaus. These are an index of employment which admirably supplement data from payrolls.

The relationship of Federal Reserve Banks to the collection of employment statistics has not yet been satisfactorily determined. The Federal Commissioner of Labor Statistics has been unwilling to receive any employment data collected by Federal Reserve Banks or any other agency except a state bureau of labor, and also has not found it feasible to segregate the data of the Bureau of Labor Statistics along state lines in order that they may be combined by the banks to give data for their districts. The Federal Reserve Bank of Philadelphia is an illustration. The bank's district includes Pennsylvania, New Jersey and Delaware. None of these states is collecting the data. The Pennsylvania Department of Labor and Industry deputized the statistician in the Philadelphia Bank to collect as its agent. The collection is being made by the bank in all three states in ac-

cordance with the uniform plan, but the Federal Bureau makes no use of the data and continues to collect its own information from plants in those districts. It has not been possible to arrange coöperation between the Federal Bureau and the bank similar to that between federal and state bureaus. A similar difficulty is encountered in the district of the Federal Reserve Bank of San Francisco. The bank has indicated to the committee its desire to obtain the employment data recommended by the committee and its willingness to coöperate in their collection. After considerable negotiation the California Bureau of Labor Statistics is now beginning to gather figures, which will be used jointly by the state and Federal Bureau and by the bank. Oregon has, also, begun to collect; Washington reports no funds for the work and no arrangements have been completed for local collection in the other states of the bank district, Nevada, Utah, Idaho and part of Arizona.

It has been the position of the committee, that failing the rapid extension of collection by the states, this segregation of its data by states, or preferably collection and detailed publication of data for Federal Reserve Districts by the Federal Bureau would be the desirable solution of this difficulty. Lacking this, the need of the Federal Reserve Banks, it seems, can be met only by their own collection of the statistics. This is one of the problems which remains to be pushed forward toward solution in the coming year. Meanwhile publication of data for geographical divisions by the Federal Bureau has been a promising development in the past year.

(7) *Coöperation with association of governmental labor officials.* Two members of the committee, Professor Lescohier and Mr. Altmeyer, represented us at the annual meeting of the Association in Chicago in May. Professor Lescohier appeared on the program, describing the work of the committee, and he and Mr. Altmeyer had interviews to further our coöperation with the Association.

(8) *Employment statistics for women workers.* At the request of our committee, the Women's Bureau of the United States Department of Labor has undertaken an analysis of employment data collected in Ohio in the wages and employment schedules in industries in that state since 1917 to determine among other things whether statistics of employment of women should be collected separately or whether the total figures now called for in the committee's recommendations are sufficient. Several of the state bureaus have made experiments in collecting current employment data by sex which indicates that this is possible in most lines of industry. Four bureaus are now regularly collecting information in this way.

CONFERENCE OF COMMITTEE

The committee held a two days' conference in three sessions on December 27 and 28, 1924, in Chicago. Eleven of the 17 members were present, and the following guests: Paul H. Douglas of Amherst College; Fred C. Croxton, Director of Columbus Council of Social Agencies; O. A. Freed, Statistician of Wisconsin Industrial Commission; Frank M. Huston, Director of the Division of Analysis of the Federal Reserve Bank of Chicago; and Miss Nanna Wigforss, in charge of employment statistics for the bank; W. I. King, Secretary of the American Statistical Association; Leifur Magnusson, American representative of the International

Labor Office; F. E. Richter of the American Telephone and Telegraph Company; George D. Roberts of the Federal Reserve Bank of New York; Bryce M. Stewart of the Amalgamated Clothing Workers of America; and from Canada: R. H. Coats, Dominion Statistician; Howard H. Ward, Deputy Minister of Labor; and Mr. C. W. Bolton, Statistician in the Department of Labor.

In addition, all state departments of labor in the United States were invited to send representatives, but except for the state statisticians on the committee, none could accept, owing to lack of funds for travel outside their states. Many expressed interest in the work and asked to be kept informed.

MEMBERSHIP OF THE COMMITTEE

The membership of the committee has continued the same, in 1924, as in the preceding year, except that Woodlief Thomas of the Federal Reserve Board has been appointed an alternate for Walter W. Stewart. A list of the members follows:

A. J. Altmeyer, Secretary, Industrial Commission of Wisconsin.
Charles E. Baldwin, Chief Statistician, U. S. Bureau of Labor Statistics.
Joseph A. Becker, Statistician, Bureau of Agricultural Economics, U. S. Department of Agriculture.
William A. Berridge, Assistant Professor of Economics, Brown University.
W. Randolph Burgess, Assistant Federal Reserve Agent, Federal Reserve Bank of New York.
R. D. Cahn, Chief Statistician, General Advisory Board, Free Employment Offices, Illinois Department of Labor.
Frederick E. Croxton, Columbia University, New York.
J. Frederic Dewhurst, Chief, Statistical Division, Federal Reserve Bank of Philadelphia.
Don D. Lescohier, Associate Professor of Economics, University of Wisconsin.
Max O. Lorenz, Director, Bureau of Statistics, Interstate Commerce Commission.
Royal Meeker, Secretary of Labor and Industry of the Commonwealth of Pennsylvania (until October, 1924).
Eugene B. Patton, Chief Statistician, New York Department of Labor.
Roswell F. Phelps, Director, Division of Statistics, Massachusetts Department of Labor and Industries.
Walter W. Stewart, Director, Division of Research and Statistics, Federal Reserve Board.
Woodlief Thomas, Division of Analysis and Research, Federal Reserve Board, Washington, D. C.
Fred G. Tryon, Statistician in charge of Coal and Coke Statistics, U. S. Geological Survey.
Leo Wolman, New School for Social Research, New York, N. Y.
Mary Van Kleeck, Director, Department of Industrial Studies, Russell Sage Foundation (Chairman).
Ralph G. Hurlin, Director, Department of Statistics, Russell Sage Foundation (Secretary).

REPORT OF THE JOINT ADVISORY COMMITTEE ON THE CENSUS

The Joint Advisory Committee to the Director of the Census, consisting of three members representing the American Statistical Association and three representing the American Economic Association, desire to report herewith to their respective Associations the operations of the Joint Committee for the year 1924.

This Committee has now completed its fifth year of coöperation on the part of the two Associations with the Federal Census Bureau. During the early period of its existence preparations were being made for the taking of the Fourteenth Census, followed by the multitude of problems which arose in the Bureau in connection with the tabulation and publication of the vast mass of material accumulated in connection with the decennial census. During the early life of the Committee, meetings were frequently held to advise the Director concerning these many problems, but with the completion of the census and the taking up of the more deliberate intercensal inquiries and the special tasks assigned to the Director, the need for frequent meetings decreased. During the past year but three meetings have been held: February 29th and March 1st, June 27th and 28th, and December 5th and 6th. The three meetings, however, have been crowded with discussion of many matters upon which the Director desired the counsel of the Committee, and it is the belief of your representatives that the meetings held this year have been unusually profitable in furnishing practical assistance to the Bureau on problems of administration, production and format.

During the year 1924 the inquiries which have been in progress in the Bureau and the other lines of activity which have occupied some of the clerical force were as follows: Institutional Population, Vital Statistics, comprising statistics of births and of deaths and also of marriage and divorce; certain special censuses of population requested by a few towns and specially paid for by them; Estimates of Population; Electrical Industries; Biennial Census of Manufactures; annual statistics of certain industries; current industrial and business statistics; Wealth, Public Debt and Taxation; Financial Statistics of State and City Governments; Census monographs; special information called for by other federal offices or by organizations and individuals; preparation for the Census of Agriculture in 1925; and the maintenance of the Mechanical Laboratory.

At the first session the Committee was able to give considerable assistance to the Director in shaping policies in connection with the report upon Wealth, Public Debt and Taxation. The second meeting was largely devoted to hearings and discussions relating to the approaching quinquennial Census of Agriculture. Representatives of the Department of Agriculture participated in these discussions, and it was the privilege of the Committee to aid in reducing the great number of questions which it was originally thought desirable to include in the schedule. The third meeting dealt largely with the problem now before the Director of revising, improving and condensing the report upon Mortality; and with the troublesome problem of estimates of population which it has been customary in the past for the Bureau to make, required in some form as the basis to determine the death rates in cities and states in the registration area; progress of work by the

Bureau upon the Agricultural Census, and upon the Biennial Census of Manufactures.

As the Fourteenth Census approached completion, the Committee urged upon the Director the importance, in view of the great volume of material accumulating with increasing population, of omitting as far as possible the text from the main reports and the substitution therefor of brief monographs upon important subjects, the preparation of which would not delay the publication of the main reports but for which there would be sufficient time to allow a careful survey of the tables so that illuminating studies upon those more important aspects of the census could be published. The Director of the Census heartily approved of this policy, and accordingly the reports were published with text much reduced and confined largely to necessary explanations, and the Committee, as has been stated in previous reports to the two Associations, undertook to aid the Director in securing competent writers for monographs upon subjects which they had suggested to the Bureau. A number of these monographs have been published. Those already issued are as follows:

Increase in Population
Mortgages on Homes
Children in Gainful Occupations
(Published as a quarto Census report.)
Farm Tenancy
Integration of Industrial Operation
School Attendance

The following are in course of preparation:

Farm Population
Immigrants and Their Children
Marital Condition
Monthly Variation in Number of Wage Earners
Women in Gainful Occupations
Recent Growth of Manufactures
Wages in Manufacturing Industries
Farm Mortgages
Growth of the Mining Industry

The Committee regrets to say that to secure suitable authors for these publications proved to be a difficult task, and much delay was encountered. The Bureau, however, heartily coöperated with the Committee in this important undertaking, but it is now greatly hampered by the reduced appropriation for printing and the extreme difficulty in securing any adequate service from the Government Printing Office. A manuscript submitted to the Public Printer, even though the funds are available to cover its cost, may be expected to require almost a year for publication; and while the theory on which the Committee proceeded has been proved entirely correct, the practical difficulties in the way have been much larger than were anticipated. It is, however, the intention of the Bureau to continue the publication of such monographs just as freely as resources permit.

Your Committee desires to call the attention of the two Associations to the fact that the Bureau of the Census is essentially a publication office. The information which it secures by authority of Congress at great labor and expense stops short of having any value unless it can be transferred to the printed page and given to the public as finished pamphlets or volumes. Over-economy in reducing the printing appropriation, or the failure of the Department to allot a sufficient sum to the Bureau from its lump appropriation, goes far toward nullifying the faithful and conscientious efforts of the Bureau in securing information. The Bureau, therefore, is in danger, if undue economy in connection with the printing appropriation is practised in the future, of proceeding with work which Congress has authorized and for which proper appropriations are provided up to the point where the information can become available, and at that point being rendered almost helpless in presenting the result of the inquiries carefully planned and properly provided for financially. Your Committee, with the approval of the Director of the Census, is submitting to the Secretary the resolution adopted at its last meeting, in the earnest hope that the influence of these two Associations will lead to more satisfactory conditions in connection with the allowance for printing. This, however, does not alter the fact that the Government Printing Office is so choked with orders for printing from Congress and the various departments of the Government that it does not seem able to meet satisfactorily the needs of the Bureau in which these two Associations are especially interested.

It is a pleasure to report to you that a subcommittee of the Joint Committee is taking up the task with the Director of the Census of securing a very adequate and effective revision of the mortality tables published annually, which they believe will prove of great assistance not only to the Bureau in better presentation of facts but also in reducing the cost of publication.

During the past year the Committee has made sixteen formal recommendations to the Director, all of which have met with his hearty approval and have been utilized by him in the regular work of the Bureau or in shaping his policies. These recommendations are appended to this report. They do not include, however, the large number of informal suggestions and recommendations which have been made to the Director at the three meetings which have been held.

In conclusion, the members of your Committee desire to express their appreciation of the skill and care with which the Director of the Census, Honorable William M. Steuart, is conducting the office. It is a matter of pride to the Committee that they were to some degree instrumental in securing the appointment of Mr. Steuart as one who had wide knowledge and experience in Census work, and their early conviction has been justified by the unusual ability which he has shown in the conduct of his office.

This Joint Committee, as the members of the two Associations will remember, is an outgrowth of that strong impulse for service which was manifested during the war, and the Committee congratulates the Associations which they represent upon the fact that of the few practical evidences of coöperation which linger after the great conflict, the assistance being given by the two Associations to an important scientific bureau is one of the most outstanding and significant. The Director of the Census is generous in his expressions of appreciation of the assist-

ance which the two Associations are rendering to him through their Joint Advisory Committee.

Respectfully submitted,

FOR THE AMERICAN STATISTICAL ASSOCIATION

William S. Rossiter, *Chairman*
Carroll W. Doten
Robert E. Chaddock

FOR THE AMERICAN ECONOMIC ASSOCIATION

Walter F. Willcox
Allyn A. Young
George F. Warren

APPENDIX

RESOLUTIONS ADOPTED BY THE JOINT ADVISORY COMMITTEE

134. The Committee recommends that in the publication of the reports on wealth, debt and taxation, 1922, statistics of debt, assessed valuation, tax levies and specified revenues be shown for counties.

135. The Committee recommends that the financial statistics of cities and states be collected on schedules of the more detailed type, such as were used in 1919 and 1923.

136. In view of the apparent omission in the assessed valuation of land in the state of Oklahoma of the values of petroleum and other mineral deposits, the Committee recommends that the value of such deposits be separately estimated, and that this item be given due weight in determining the ratio of assessed to true values. The Committee is further of the opinion that in the reports for 1922 it should be stated that the estimate of the value of taxed real property in Oklahoma in 1912 was probably too high.

137. The Committee recommends that the value of national parks should not be included in the estimates of national wealth for 1922.

138. The Committee is of the opinion that the manuscript entitled "Digest of Patents relating to Coal Tar Drugs, etc.," should be printed, either as a Government publication or in some other manner.

139. That for the present no birth or death rates be published where the 1922 population as estimated by the arithmetical method differs by more than 10 per cent from the population estimates made by the use of statistics of deaths and births for 1922.

140. That a subcommittee of two be appointed to consult with the Census Bureau about the matter of estimating population, and that Dr. Willcox and Professor Chaddock be the members.

141. The Committee is satisfied that the methods employed in estimating the value for 1922 of railroads, of electric railroads, telegraphs and telephones, furniture and other household equipment, and wearing apparel, of tax-exempt property, have been decided upon after careful consideration and should give increased accuracy to the estimate of national wealth.

142. The Advisory Committee to the Bureau of the Census has learned with deep regret of the death on November 3, 1923, of Charles S. Sloane. Trained by Henry Gannett, Geographer of the Census of 1880, 1890 and 1900, Mr. Sloane succeeded him on his retirement and laid the geographic bases for the Censuses of 1910 and 1920. He was an accurate and tireless worker, and a mine of information upon the many complicated questions arising within his field. On many occasions he materially aided

the Committee, and won their esteem by his knowledge and his character. His death leaves a gap it will be very hard to fill.

143. The Committee believes that the utility of the Survey of Current Business would be increased, while at the same time its cost, in the long run, would be decreased, by publishing it as follows:

(1) A large volume, to be issued at, say, quinquennial intervals, in which the different series should be carried back, so far as possible, to 1913; (2) semi-annual numbers, in which the series should be continued from the last previous quinquennial issue; (3) monthly numbers, which should be continuations of the last previous semi-annual number.

144. The Committee believes that the cutting down of the Bureau's printing appropriation has seriously hampered the work of the Bureau, and is likely to diminish its value. The Committee is in full sympathy with efforts to secure the utmost possible measure of economy in the operations of the Bureau of the Census. It has frequently advised reductions in the size or scope of census publications, and it has consistently urged the simplification of various inquiries made by the Bureau. But the Committee does not believe that either economy or efficiency can be secured by cutting down any one class of expenditure, such as that for printing, so that it becomes the factor which determines and limits the general scope of the Bureau's activities. Substantially all of the work of the Bureau of the Census has to be embodied, in its final form, in printed publications. A due proportion has to be maintained between printing costs and other outlays, otherwise much effort and expense must be wasted, and inquiries undertaken in compliance with law must be mutilated in such a way as to impair their value.

145. The Committee heartily approves the proposed reduction in the amount of tabular matter to appear in the forthcoming Mortality Report to meet the situation created by the shortage of funds in the printing appropriation. The opinion is again expressed that permanent radical changes in amount and form of statistics presented in the annual reports on births and deaths should be made without delay. To that end, the Committee directs the appointment of a subcommittee of three, to consist of Messrs. Willcox, Young and Chaddock, to prepare for submission to the Director a statement embodying proposed changes in this publication.

The Committee empowers said subcommittee to accompany their report with such recommendations as they deem advisable, to be presented in the name of the entire Joint Committee.

The said subcommittee is hereby further empowered to present to the Director, in the name and with the authority of the entire Joint Committee, such recommendations as they may decide upon concerning estimates of population, after inspection of the memoranda and experimental tests made in accordance with the request of the entire Committee at this meeting.

146. The Committee is of the present opinion that the publication of estimates of population for counties and of rates based upon such estimates should be discontinued, but before making a final recommendation desires to be more clearly informed respecting the possible reasons for continuing the publication of such estimates and rates.

147. The Committee, being impressed with the importance of adequate compilations of statistics of misdemeanors and crimes, recommends that the Bureau of the Census take steps to canvass the field to ascertain what information is available and how the data may be best improved and utilized.

148. In view of the existing exigency resulting from the curtailment of the Bureau's allotment for printing, the Committee is of the opinion that the Bureau would not be justified in tabulating the special data which were included on the prison card at the

request of the representatives of the American Prison Association so long as the expense of publishing the results can only be met by sacrificing or further curtailing some of the Bureau's regular reports, which are required by law.

149. The Committee expresses the hope that despite the reduction in printing appropriations, the publication of further monographs will not be halted.

AN INDEX OF PROFITS

The central importance of profits in business cycle phenomena has been emphasized by most students of the subject. Much has been written, but little has been accomplished in the way of direct statistical measurement and analysis. Indexes of production, volume of trade, unemployment, interest rates, volume of credit, volume of wholesale and retail trade, etc., have been constructed and the relationship between them carefully analyzed, but no one has attempted an index of profits that would show the relative fluctuation of profits in different types of industry or give a properly weighted average index of profits for all types of industry. This neglect of the study of profits by statisticians has probably been due in part to the difficulty of securing adequate data. True there is a complete census of corporate earnings published in the official *Statistics of Income*, but of necessity the data contained in this publication are about two years old by the time they are published. For many purposes more recent data are needed. There remain the published reports of a large number of corporations which are assembled in such publications as Moody's and Poor's manuals and the Standard Corporation Card Service. It would seem that there is a large enough quantity of data assembled in these volumes to make the calculation of a profits or earnings index a fairly simple matter, but the difficulties are considerable. (1) Accounting systems are not uniform, so that it is difficult to know whether the net income statements are comparable for different companies or for the same company in different years. (2) The accounting period, or fiscal year, varies from company to company, and within the same company it may vary for different years. (3) Income statements may appear for a particular company for several years and then disappear because of the failure of the company or because of its consolidation with another company. (4) Even though the income statements may be continuous for a considerable period of years the series may not be comparable for the whole period because of consolidation or the absorption of other large corporations.

The Standard Statistics Company has recently attacked this problem and has published the results in its *Standard Daily Trade Service* for October 27, 1924. The index presented in this place is based upon annual data, but a quarterly index is promised for the near future.

The annual index dates back to 1921 only. To have carried it back much further would have necessitated a considerable reduction in the number of companies included in it. As it was constructed it contains 934 companies. Of these 704 are classed as industrials, 157 as public utilities, and 73 as railroads. The public utilities are subdivided into (1) electric light, power, gas, water, etc., (2) telephone and telegraph, and (3) traction companies. The industrials are divided

into thirty-four groups. One of these, containing 55 companies, is a retail trade group; one a theater group; one an express, trucking and warehouse group, and one a coal mining group. The remaining thirty groups apparently represent different branches of manufacture. There is no explanation regarding the basis for the classification of companies except the statement that the groups are those which will be of interest to the investor. It appears, however, from an examination of the groups of companies that a guiding principle in their formation was the type of market on which the goods are sold. Thus the broad distinction between producers' and consumers' goods is recognized, but the principle is carried still further in the case of producers' goods in the following classifications: farm implements, fertilizer, office and business equipment, railway equipment, and building materials. Other groups of companies are based upon the physical similarity of their products, such as iron and steel, cotton goods, woolen goods, chemicals, etc. Even these classifications, however, possess an economic significance beyond that of mere physical similarity of product.

The net income available for interest and dividends is the figure used in making this index. This income, however, is not expressed in dollars, but as a rate of return on the "capital invested in the business or alleged to be invested in the business." Capital as used here is considered to be the surplus plus the par value of all the securities (stocks and bonds) outstanding. The index of profits, then for each of the three major classes of business and for each sub-class is determined by totaling the income and the capital for all of the included companies and expressing the former as a percentage of the latter. These percentage figures are later cast into relatives using the three years' average profits (1921–1923) for each group as the base.

No systematic weights are used in determining the average profits for either the major groups or the sub-groups. It is alleged that the index for each group is a weighted average in that these averages are obtained by expressing the total income as a percentage of the total capital for all the included companies rather than by taking a simple average of the rates of profits for the individual companies. This results in giving large companies heavier weights than small companies, but it does not give the different types of industry weights in proportion to their importance. The food products group, for instance, is probably made up of meat-packing companies, flour milling companies, canning companies, candy and confectionery companies, etc. The profits of the flour-milling companies would be expected to fluctuate less than the profits of candy manufactures or meat packers; at least, they would be expected to fluctuate from a different set of causes. Since the fluctuation of profits for these different branches of the food products group is probably quite different, the problem of assigning them proper weights is a very important one. Each branch should be given a weight proportionate to its importance in the food products group, and not on the basis of the number and size of the corporations which happen to be included in each of these branches. A measure of relative importance in this connection would be relative earnings. The same is true of the index for the whole industrial group. The indexes for the sub-groups,—food products, iron and steel, farm implements, textiles, automobiles, etc.,—should be assigned weights in proportion to their

relative importance in arriving at the index for all industrial corporations. A total of the earnings of the 704 corporations contained in the industrial group does not give such a weighted index of income for all industry, neither does the ratio of total income to total capital give such a weighted index of the rate of profits. This results rather in a haphazard weighting, depending upon the number and size of the corporations included in each sub-group and in the various branches of the sub-groups.

The method adopted here of expressing net earnings as a percentage of the surplus plus the par value of all securities outstanding has little to recommend it. Surplus plus par value of securities may or may not bear a close relationship to the actual invested capital. In many cases it is known that the relationship is remote. The rate of profits expressed upon such a base, then, cannot be used to show the true rate of return on invested capital. Furthermore, an index constructed on this basis cannot be relied upon to show the full effects of depression or prosperity upon different types of industry, since part of the change in the ratio of net income to "capital" from depression to prosperity may be due to a change in financial organization or in accounting practice of one or more of the companies included in the index. The statisticians who constructed this index recognize this, but justify their practice on the ground that "raw dollar figures are not comparable"; that therefore they must be reduced to a common denominator, and that if the property values are inflated "the earnings report of a particular company should be correspondingly penalized." For these reasons it is held that the index as constructed will be of greatest use to the investor for whom it is primarily intended. It appears, however, that if it is important for the investor to know something about the surplus and the par value of outstanding securities, this fact can be better presented to him in a separate table. Then any changes taking place in these figures would be clearly evident. Also, if a separate index of earnings were presented it would be perfectly clear to what extent different types of business are affected by prosperity and depression. As it is, one cannot know to what extent changes in the indexes for various groups are due to changes in earnings or to changes in the "capital" base. This is the type of comparison that will be of most interest to investors; that is, a comparison of the extent to which different industries are enjoying prosperity or suffering from depression, and a straight index of dollar earnings, cast into relatives, will serve best for this purpose.

Economists and statisticians should welcome the work of the Standard Statistics Company in this field because this is an established organization which gives assurance that this index will be kept up to date as other important indexes are, and because of the contacts of this organization with a large number of corporations it is in an unusually good position to judge of the adequacy and comparability of the published data which it is necessary to use in making an index of profits. It is to be hoped, however, that the Standard Statistics Company will see fit to turn the income data for these groups of companies into an index of earnings to be published along with their index of the ratio of income to "capital."

C. R. CHAMBERS

Washington, D. C.

INDEX OF BUSINESS PROFITS *

(In dollar figures, showing for each group the dollars earned on each $100 of capital)

	No. of Cos.	1923	1922	1921	Three-Year † Weighted Average
ALL GROUPS	934	$6.75	$5.75	$3.50	$5.75
ENTIRE INDUSTRIAL GROUP	704	7.75	6.50	2.25	6.50
Automobiles	26	15.50	12.50	6.75 ‡	12.00
Automobile Accessories	31	15.75	14.75	4.50	14.25
Building Materials, Supplies and Real Estate	42	12.00	8.75	3.75	9.75
Chemicals	21	9.50	7.25	4.00	7.75
Clothing	17	9.75	10.25	4.50	9.00
Coal	19	4.00	2.75	3.25	3.50
Copper and Brass	34	3.50	.75	2.75 ‡	1.75
Electrical Equipment	10	10.00	8.75	6.75	9.25
Express, Trucking and Warehouse	6	6.50	5.50	5.00	5.75
Farm Implements	9	2.25	.25 ‡	2.25 ‡	.75
Fertilizer	5	1.75	1.75	10.75 ‡	.75 ‡
Food Products	52	9.50	8.00	1.50	7.50
Gold and Silver	20	8.00	9.50	6.75	8.75
Household Supplies	20	13.00	12.25	.75 ‡	11.00
Lead, Zinc, Nickel	10	6.00	4.00	1.00 ‡	4.50
Leather	4	4.00 ‡	3.50	10.50 ‡	2.50 ‡
Machinery	22	7.75	4.25	1.25 ‡	4.75
Office and Business Equipment	13	8.00	5.50	2.50	6.25
Oil	83	6.25	7.25	5.00	6.50
Paper	14	7.00	2.00	0.00	4.00
Printing, Publishing and Printing Equipment	11	7.75	7.25	7.00	7.50
Railroad Equipment	21	11.00	6.00	5.00	8.00
Retail Trade	55	12.25	10.25	1.75	9.75
Shipping and Ship Building	14	2.25	3.75	3.75	3.00
Shoes	5	10.75	11.25	5.50	10.00
Steel and Iron	47	6.50	3.00	2.00	4.75
Sugar	23	9.75	3.25	10.75 ‡	5.00
Textiles-Cotton Goods	14	5.25	2.25	3.75	3.50
Textiles-Woolen Goods	4	5.75	5.25	3.00	5.50
Textiles-Miscellaneous	4	9.00	8.50	1.50	7.50
Theaters	4	7.00	6.50	7.00	7.00
Tires and Rubber Goods	12	6.25	7.00	3.50 ‡	5.00
Tobacco	20	10.00	11.00	10.00	10.50
Miscellaneous	12	13.50	13.25	8.50	12.75
ENTIRE PUBLIC UTILITY GROUP	157	6.75	6.50	5.75	6.50
Electric Light Power, Gas, Water, etc.	119	7.00	6.75	5.75	6.75
Telephoning and Telegraph	13	7.00	7.25	6.75	7.00
Traction	25	5.00	4.75	4.25	4.75
ENTIRE RAILROAD GROUP	73	5.00	4.25	4.25	4.75

* Reprinted from the *Standard Daily Trade Service*, October 27, 1924, published by Standard Statistics Co., Inc., 47 West Street, New York City.

† In computing this three-year average the data for 1921 were given a weight of 1, data for 1922 a weight of 2, and data for 1923 a weight of 3.

‡ Deficit.

A NOTE ON ALMSHOUSE POPULATION

The Bureau of the Census issued a pamphlet recently, giving the results of the January 1, 1923, Census of Paupers in Almshouses. This report has been interpreted as showing that the Negro makes as good a showing as the white, for while the Negro constitutes 9.9 per cent of the total population of the country, the race contributed only 7.1 per cent of the total to the almshouse population. For the following reasons, such a comparison of the crude figures is of little value.

The southern states [1] contained 85.2 per cent of our Negro population, but

[1] States south of Mason and Dixon's line, the Ohio River, Missouri and Kansas.

only 31.3 per cent of the total population, and 16.7 per cent of the paupers in almshouses. The northern states [1] contained 48.4 per cent of the total population, overwhelmingly white, and 63.4 per cent of the almshouse population. These figures merely indicate that the northern states have the wealth to support a much higher percentage of almshouse population, and because of climate have the necessity of so doing.

The southern states possessed 19.3 per cent of the estimated total national wealth in 1922.[2] The northern states possessed 53.3 per cent. These figures have a marked correlation with the percentage contributed by the two sections to the total number of paupers in almshouses. As to number and size there were 63 almshouses in New York, 100 in Illinois, 69 in Georgia, and 60 in Mississippi, no great difference between two typical northern states and two southern. The difference in average number of inmates is marked, 191 in New York, 54 in Illinois, 12 in Georgia, and 7 in Mississippi.[3]

A shack which will give sufficient protection in the South to warrant a person staying out of an almshouse will be totally inadequate through a northern winter. Because of this the four northern states, Massachusetts, New York, Ohio and Illinois, have a "turnover" of almshouse population 2.8 times the "turnover" of the four southern states, South Carolina, Georgia, Alabama and Mississippi. That is to say, the average number of transfers and discharges per year in the four northern states was 79.1 per cent of the total number of almshouse inmates in those states, while in the four southern states it was only 28.1 per cent of the total.

The enumeration of paupers in almshouses was taken on January 1, 1923, in midwinter, when this transient white almshouse population of the North was probably near its maximum.

Examining the evidence by states, we find that in Georgia the Negro contributed 41.7 per cent to the total population of the state and the same percentage to the almshouse population. In Mississippi 52.2 per cent of the total population was Negro, but 57.1 per cent of those in almshouses were Negro. In New York Negroes contributed 1.5 to the general population and 1.6 to the almshouse population, in Illinois the figures are 1.9 and 2.6, in Indiana 2.2 and 3.9, in Pennsylvania 2.5 and 4.1, and in Ohio 2.3 and 5.1[4] In each state mentioned above, the Negroes contributed to almshouse pauperism in excess of their representation in the population.

The figures of the almshouse census in 1923 show that nearly 40 per cent of all those in almshouses were over 70 years of age. Pauperism is an affliction of old age.

Negroes over 70 constitute 1.9 per cent of the total Negro population, while whites over 70 represent 2.8 per cent of the total white. Half again as many whites, proportionally, reach 70 years. Negroes contribute 9.9 per cent to the total population, but only 6.8 per cent to the total population over 70, the pauper age.

[1] States north of Mason and Dixon's line, and east of the Mississippi.
[2] Estimated Value of National Wealth, 1922. Bureau of the Census.
[3] Bureau of the Census, Report on Paupers in Almshouses, 1910. 1920 figures not available.
[4] Using the figures for the Census of 1920 and the Paupers in Almshouses for 1923.

Turning to differences by nationality it has been assumed,[1] on the basis of the crude figures, that Ireland and Germany, favored by our immigration laws, at present contribute far more than their share, proportionally, to the paupers in almshouses, while Italy and Russia, countries discriminated against, furnish the fewest numbers to our almshouses in proportion to the number of the foreign-born resident in this country.

During the period 1830 to 1920, 4,300,000 Irish, 5,500,000 German, 4,200,000 Italian, and 3,400,000 Russian immigrants came to this country. But half of the Irish came before 1867, half of the German before 1874, while half of the Russians have arrived since 1907, and half of the Italians since 1906. Patently, therefore, the proportion of Irish and German who are now over 70 years of age is much greater than the proportion of Italians and Russians.

Until allowance for geographical distribution and for age classification is made, any comparison of races or nationalities on the basis of the Census Bureau's report is almost sure to be quite misleading.

PERCY L. CLARK, JR.

Cornell University.

PROCEEDINGS OF THE EIGHTY-SIXTH ANNUAL MEETING OF THE AMERICAN STATISTICAL ASSOCIATION

CHICAGO, ILL. DECEMBER 29–31, 1924

PROGRAM

GENERAL TOPIC FOR ALL SESSIONS: *The Population Problem in America Today*

MONDAY, DECEMBER 29

10.00 A. M.—First Session, Irving Fisher, presiding
Topic: "Statement of the Problem,
Paper: "The Rate of Growth of the American Population,
E. B. Reuter, University of Iowa
Paper: "The Urbanization of the American Population"
Hornell Hart, Bryn Mawr College
Paper: "The Sources of Natural Increase of Population"
Warren S. Thompson, Miami University
Paper: "The Limit of American Population"
Howard Woolston, University of Washington
Discussion:
E. H. Sutherland, University of Illinois
Harold Hotelling, Food Research Institute, Standford University
R. E. Baber, University of Illinois

2.00 P. M.—Second Session (Joint Meeting with the American Economic Association), Louis I. Dublin, presiding
Topic: "Population and Natural Resources"
Paper: "The Economists' View of the Population Problem"
A. B. Wolfe, Ohio State University
Paper: "Agriculture and Population"
Don D. Lescohier, University of Wisconsin

[1] Raymond Pearl in Science for October 31, 1924, p. 394.

Paper: "The Economics of the American Farm"
David Friday, New School for Social Research
Paper: "Increase in Efficiency of Farm Production"
Alonzo E. Taylor, Stanford University
Paper: "Mineral Resources for Future Populations
Frederick Gale Tryon and Lida Mann, U. S. Geological Survey
Discussion:
T. N. Carver, Harvard University
Winford Lee Lewis, American Institute of Meat Packing, Chicago, Ill.

8.00 P. M.—Joint Meeting with American Economic Association and American Sociological Society
Presidents' Addresses:
"Intolerance," Charles A. Ellwood, American Sociological Society
"Quantitative Analysis in Economic Theory," Wesley C. Mitchell, American Economic Association
"The Statistician and the Population Problem," Louis I. Dublin, American Statistical Association

TUESDAY, DECEMBER 30

9.00 A. M.—Business Meeting: Committee Reports and the Election of Officers

10.00 A. M.—Third Session
Topic: "Population and Immigration"
Paper: "The Racial Composition of the American Population"
Henry Pratt Fairchild, New York University
Paper: "The Contribution of Alien Heritage to National Cultural Development"
Alexander Goldenweiser, New York School for Social Research
Paper: "The Effect of Infusion of Alien Racial Stocks Upon the Development of an American Type"
A. Hrdlicka, Smithsonian Institution
Paper: "A Rational American Immigration Policy; Its Basis and Goal"
W. W. Husband, Commissioner General of Immigration
Paper: "The Immigration Problem of Canada"
R. H. Coats, Dominion Statistician
Discussion:
Jane Addams, Hull House, Chicago
Edith Abbott, University of Chicago
Herbert A. Miller, Ohio State University

2.00 P. M.—Fourth Session (Joint Meeting with American Association for Labor Legislation), Louis I. Dublin, presiding
Topic: "Population and Labor Supply"
Paper: "The Training and Direction of Our Labor Supply"
George Soule, Labor Bureau, Inc., New York City
Paper: "The Wider Occupational Opportunities of Women and the Population Problem"
Susan Kingsbury, Bryn Mawr College
Paper: "Influence of Child Labor Restrictions on Population"
Grace Abbott, Chief, U. S. Children's Bureau
Paper: "The Management of Unemployment and Labor Supply"
Bryce M. Stewart, Unemployment Insurance Office of Men's Clothing Industry

Discussion:
B. M. Squires, Trade Board, Men's Clothing Industry
Harry Jerome, National Bureau of Economic Research
8.00 P. M.—Meeting of Board of Directors

WEDNESDAY, DECEMBER 31

9.00 A. M.—Business Meeting
10.00 A. M.—Fifth Session, James A. Field, presiding
Topic: "The Outlook for the Future"
Paper: "The Family Wage and the Future Population"
Paul H. Douglas, University of Chicago and Amherst College
Paper: "The Effect of the Health Movement on the Population of the Future"
S. J. Holmes, University of California
Paper: "The Essentials of an Optimum Social Organization in the Future Population"
R. M. MacIver, University of Toronto
Paper: "Methods of Approach to the Population Problem of the Future"
Mary Van Kleeck, Russell Sage Foundation
Discussion:
Irving Fisher, Yale University
William F. Ogburn, Columbia University
Maurice B. Hexter, Federated Jewish Charities of Boston

MINUTES OF THE ANNUAL BUSINESS MEETING

The annual meeting of the American Statistical Association was called to order by the President, Dr. Louis I. Dublin, at 9.00 A. M., December 30. The report of the Secretary was read by Willford I. King and was accepted by the Association and ordered printed in the proceedings.

In the absence of the Acting Treasurer, Robert E. Chaddock, his report and that of the Auditing Committee were read by the Secretary. Both were approved by the meeting.

The report of the Joint Committee on the Census was presented by Professor Walter F. Willcox, but was not read. At the request of Professor Willcox, the meeting instructed the Secretary to place the report on file.

Professor Willcox next presented the report of the Committee on an Encyclopedia of the Social Sciences. A motion was carried to continue the Committee and to recommend to the Board of Directors the appropriation of a sum of not more than $100 to help pay the expenses of the Committee.

It was moved by Professor Willcox and seconded that the following resolution be adopted:

The American Statistical Association hereby records its belief that the time has now come when scholars from all countries should participate on equal terms in scientific congresses at which it is invited to be represented. The American Statistical Association is of the opinion that no invitation to participate in future international congresses should be accepted by it unless the rules of the congress allow scholars of all countries to participate on equal terms.

An amendment was offered, making this motion read as follows:

Resolved that the American Statistical Association holds it desirable that all scientific meetings at which it is represented should be open to the scientists of all countries, without regard to the participations of their nations in the Great War.

The amendment was adopted, and the original motion, as amended, was then carried.

Miss Mary Van Kleeck presented the report of the Committee on Governmental Labor Statistics. The report was accepted and the meeting authorized the continuation of the Committee.

It was moved and carried that the following resolution be entered upon the records of the Association and the Secretary was directed to send a copy thereof to the Director of the Russell Sage Foundation:

The American Statistical Association hereby expresses its grateful appreciation of the assistance, both financial and advisory, rendered by the Russell Sage Foundation to the Committee on Governmental Labor Statistics, thereby making much more effective than would otherwise have been possible the work of the Committee, and in this expression it desires to recite the forms in which such assistance has been rendered:

1. Provision of a meeting place and office headquarters for the Committee in the Russell Sage Foundation Building in New York City.
2. Payment of the traveling expenses of certain members of the Committee living at a distance from New York, who otherwise would have been unable to attend the meeting of the Committee either in New York or Chicago.
3. Making available to the Committee of the very efficient and gracious services of its Chairman, Miss Mary Van Kleeck, and its Secretary, Mr. Ralph G. Hurlin, both of whom are members of the staff of the Russell Sage Foundation.
4. Bearing certain of the stenographic and clerical expenses of the Committee—a no small item in itself—and
5. Proposed publication of the Report of the Committee in the form of a Monograph on the "Collection of Employment Statistics," or similar title, arrangements for the publication of which are now being perfected.

The next report was by Professor William F. Ogburn, Editor of the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION. He advocated either enlarging the JOURNAL, or increasing the number of issues per annum. His report was accepted, but no action was taken upon his recommendation.

The Nominating Committee offered the following nominations for offices for the year 1925: President, Robert E. Chaddock; Vice-Presidents, Edwin F. Gay, Henry L. Rietz, Walter W. Stewart; Secretary-Treasurer Willford I. King; Counsellors, Louis I. Dublin, Joseph E. Pogue, Fred G. Tryon; Editor, William F. Ogburn; Librarian, Horace L. Wheeler.

No other nominations being made, the Secretary was instructed to cast the unanimous ballot of the Association for the ticket presented. This was done, and all officers on the ticket were declared elected.

Leonard P. Ayres, Chairman of the Committee on Fellows, presented the report of his committee for 1924. It was accepted by the meeting.

The meeting adjourned.

WILLFORD I. KING, *Secretary*

The American Statistical Association met on Wednesday, December 31, at 9.00 o'clock. Dr. Louis I. Dublin presided.

In the absence of the members of the Committee on Institutional Statistics, the report of that Committee was read by the Secretary. A motion was carried to accept the report of the Committee and to endorse the effort of the Bureau of the Census to improve the statistics collected for institutions in the United States. The following resolution was therefore adopted:

Resolved by the American Statistical Association that it endorses the work of its Committee on Institutional Statistics and the recommendation of that Committee that Congress be asked to provide the funds necessary to enable the Bureau of the Census to compile a condensed annual statistical report of the institutions in the United States dealing with the mentally and physically ill, the dependent and delinquent classes, and the care of children.

In the absence of the members of the Committee on Educational and Professional Standards, the report of that Committee was read by the Secretary. It was accepted by the Association.

The report of the Committee on Personnel Classification in the Federal Government was next presented and accepted by the Association. The Committee was continued.

In accordance with the resolution of the Board of Directors, the Secretary presented to the Annual Meeting the following amendment to the Constitution:

The last sentence of Article VIII of the Constitution is hereby amended to read, "President, Vice-Presidents, Secretary, Treasurer, Counsellors and the person or persons holding the presidency of the Association during the two preceding years shall form a Board of Directors for the government of the Association, three of which shall constitute a quorum at any meeting regularly convened."

The amendment was passed by the meeting and submitted to the next Annual Meeting for adoption.

It was moved and carried to extend a vote of thanks to the Editor and the Editorial Board for their meritorious services to the Association during the past year. It was further moved and carried to extend the thanks of the Association to the President for the admirable program which he had planned and to the Local Committee for their successful efforts in arranging for the accommodation of the Association while in Chicago. The following resolutions were therefore offered and the Secretary was directed to enter them upon the records of the Association:

Be it resolved by the American Statistical Association that a vote of thanks be extended to the Editor and to the Assistant Editors of the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION for their effective and successful efforts in editing the Journal during the year 1924, and for maintaining this publication at such a high standard of excellence.

Be it resolved by the American Statistical Association that a vote of thanks be hereby extended to its President, Dr. Louis I. Dublin, for the planning and preparation of the interesting and instructive program presented at the Chicago meeting of the Association.

Be it resolved by the American Statistical Association that the thanks of the Association be extended to the members of the Local Committee who made such adequate and satisfactory arrangements for accommodating the meeting of the Association at Chicago.

The meeting adjourned.

WILLFORD I. KING, *Secretary*

Report of the Acting Treasurer, 1924

Receipts

Membership dues		$5,308.71	
Sales, single copies and sets of JOURNAL		908.05	
Sales, Memorial Volume:			
Sales direct to members	$84.35		
Sales of Macmillan Company	110.93		
Total		195.28	
Advertising in JOURNAL		425.00	
Subscriptions to the JOURNAL		1,597.03	
Dividends on B. & A. R. R. stock		148.75	
Balance from 1923		2,402.68	
Total receipts			$10,985.50

Expenditures

Printing:			
Printing four issues of JOURNAL:			
December, 1923, issue	$1,221.76		
March, 1924, issue	848.66		
June, 1924, issue	918.40		
September, 1924, issue	1,174.95		
Author's reprints, four issues	262.06		
Total printing of JOURNAL	$4,425.83		
Other printing, stationery, etc.	533.44		
Total printing, stationery, etc.		$4,959.27	
Postage		178.93	
Salaries		2,142.04	
[1]Miscellaneous expenses		413.19	
Deposited as savings in Bowery Savings Bank, New York City		3,000.00	
Cash balance on hand, December 15, 1924		292.07	
			$10,985.50

Report on Memorial Volume Fund, 1924

Receipts

Sales to members at $3.50 rate	$84.35	
Sales through Macmillan Company	110.93	
Total receipts		$195.28

[1]This item in the budget is larger than in previous years due to the purchase of equipment for the Secretary's office.

There were no expenditures during the year. Therefore, these receipts apply to the deficit of previous years paid out of the general funds of the Association, $471.73, leaving a deficit to date of $276.45. It should be noted that all debts connected with the publication of this volume have been met in full either from sales of the volume itself or from general funds. At present, the sales of the volume have not yet met the expense of its publication by the amount of $276.45. However, over 200 volumes still remain in the possession of the Association, and each year's sales reduce the deficit.

Assets

The Association owns without encumbrance seventeen shares of Boston and Albany Railroad stock, and has accumulated savings in the Bowery Savings Bank, New York City, amounting to $3,000, together with six months' accumulated interest at 4 per cent.

Before the close of the year, the Board authorized equipment for the office of the Secretary, located at 474 West 24th Street, New York City, consisting of a typewriter, desk, filing case and other accessories which are now the property of the Association.

ROBERT E. CHADDOCK, *Acting Treasurer*

Report of the Secretary, 1924

Willford I. King was elected Secretary by the Board of Directors in accordance with the authorization conferred upon the Board at the last annual meeting. Professor Robert E. Chaddock turned over to him the duties of the office on November 1, 1924. The Board having authorized the hiring of an assistant to the Secretary, Miss Rennette Seltzer was employed for this purpose, beginning her duties on November 1, 1924.

Membership, December, 1923			1,041
Additions during 1924		151	
Deductions during 1924:			
Deaths reported during 1924	9		
Resignations during 1924	34		
Dropped because unable to locate	11		
Dropped for non-payment of dues	3		
	—	57	
		—	94
Membership, December, 1924			1,135
Besides members, we have:			
Subscribers, mostly libraries		309	
Domestic exchanges		28	
Foreign exchanges		76	
		—	413
Total members, subscribers and exchanges			1,548

The following deaths have been reported during the year: John B. Garrett, Dr. Henry J. Harris, Isaac A. Hourwich, Hon. Charles W. Lippitt, H. W. St. John, Dr. Dudley A. Sargent, Dr. Brandreth Symonds, Louis C. Taylor, and Prof. George C. Whipple.

Four numbers of the JOURNAL, and a handbook, 51 pages, for the volume, have been issued during 1924, or 613 pages, completing Volume XIX. A total of 18 pages of advertising appeared in the four issues at the rate of twenty-five dollars per page.

Three special meetings and dinners have been held in New York City during the year. The attendance was respectively 100, 100 and 110. One such meeting was held in Boston.

A new employment clearing house has been initiated for the benefit of members seeking employment or desiring to secure help.

Report of Committee on Institutional Statistics

During this past year your Committee on Institutional Statistics has endeavored to secure the introduction, through the Federal Children's Bureau, of the statistical system for institutions for children that was submitted to the Association at its last annual meeting. Negotiations for printing the statistical manual outlining the system were begun with the Children's Bureau early in the year. It was hoped that the Bureau would publish the manual and distribute it to the principal institutions for children throughout the country with the recommendation that it be used by such institutions. In submitting the manual to the Bureau it was suggested that if modifications seemed desirable, this Committee would meet representatives of the Bureau in conference so as to effect a final agreement as early as possible.

The manual was examined by the Bureau, and the chief of the Bureau expressed her willingness to print it, with some amendments, as a part of the handbook issued by the Bureau for the use of institutions. Before action could be taken in the matter, the rates for printing were increased by the Government Printing Office, so that it became impossible for the Bureau to print the manual.

As the manual was not returned to the Committee until December 20, 1924, there has been no opportunity to submit it to other organizations. There are several foundations interested in promoting child welfare, and it seems probable that some of them might be induced to pay the expense of printing the manual and of introducing the proposed uniform system of statistics in institutions for children. At the present time it is impossible to collect anything but the crudest statistical material from such institutions.

The Director of the Federal Census Bureau, in discussing the progress of the recent census of institutions in his annual report, made the following statement:

"It has been found more difficult to collect satisfactory statistics concerning the institutions for the care of children than for any other of the various classes of institutions covered by this inquiry. There is no authentic list of these institutions, and in many localities there are apparently no laws or local ordinances governing their operations. They appear to be organized and abandoned with-

out special authorization of any character. The Bureau has canvassed every known source of information in the attempt to prepare a complete list of the institutions of this class. An extensive mail canvass was in operation for several months, and this was supplemented by the employment of special agents. Even now, when the field work is finished, it is not certain that the list is complete, and accordingly arrangements have been made to issue mimeographed lists, one for each state, giving the names of the institutions canvassed, together with the number of inmates on February 1, 1923, classified by sex in most cases.

"Not only was it difficult to obtain the names of these institutions, but in the vast majority of cases there was apparently no satisfactory record of the children committed and their disposition. It was felt that in many respects this branch of the investigation was of the greatest importance, and every effort was made to compile complete and satisfactory statistics. It is regretted, however, that in most cases apparently no local laws or ordinances have been enacted to require these institutions to keep proper records of their transactions."

Several members of this Committee on Institutional Statistics have coöperated with the Federal Census Bureau in tabulating and analyzing the data obtained in the census of institutions taken as of January 1, 1923.

The Director of the Census Bureau and his associates are entitled to great credit for their willingness to coöperate in the preparation of this census with national organizations interested in the various classes of institutions.

The census reports soon to be issued will be greatly reduced in size owing to increased cost of printing and insufficient appropriations, and some important material will have to be left out.

This Committee has suggested to the Federal Census Bureau the desirability of compiling a condensed annual statistical report of institutions. The Director has expressed his willingness to undertake the work provided funds therefor can be secured from Congress. As there are now nearly 20,000 institutions caring for the mentally and physically ill, the defective, dependent and delinquent classes, the necessity of annual authoritative data concerning these agencies is obvious.

This Committee would therefore respectfully recommend that the Association endorse the project and assist the Federal Census Bureau in securing the necessary funds from Congress to carry on the work.

It is also recommended that an effort be made to secure funds during the coming year for the publication and introduction of the statistical system for institutions for the care of children, prepared by this Committee.

Respectfully submitted,

Horatio M. Pollock, *Chairman*
Edith Abbott
Kate H. Claghorn
Edith M. Furbush
Joseph A. Hill
Robert M. Woodbury
Committee on Institutional Statistics

Report of the Committee on Personnel Classification in the Federal Government

A year ago the Federal Budget disclosed the fact that the Federal Personnel Classification Board, created under the Classification Act of 1923, had failed to recognize the scientific, technical character of many economic, sociological and statistical positions in the service of the National Government. The Board had placed these positions in the clerical, administrative and fiscal service established under the Classification Act. This action, unless corrected, might have resulted in permitting positions of this character to be filled by persons not possessed of the requisite technical training for the adequate performance of this important branch of government work. It also resulted in applying to these positions schedules of grades and salaries that were designed for clerical and administrative positions and were entirely inapplicable to scientific and technical positions in the fields of economics, sociology and statistics. This Association accordingly appointed this Committee to prepare a brief on the subject and to take such other action as might aid in bringing about proper classification.

In accordance with the terms of the resolution, the Committee of this Association coöperated with similar committees from other associations in an effort to have one common brief from the American Economic Association, the American Sociological Society, the American Statistical Association, and the American Association for Labor Legislation. This effort at coöperation was successful, but because of obvious difficulties it delayed the final approval of a common brief. The brief was not submitted because before it had received the last approval, the Personnel Classification Board reversed its position previously taken, and formally recognized the scientific and technical character of economic, sociological and statistical work.

In the Board's document of July, 1924, entitled, "Class Specifications for Positions in the Departmental Service," the first group in the Professional and Scientific Service is one entitled, "The Economic Analyst Group." The first definition in this group begins, "To perform under immediate supervision, simple and elementary professional, scientific or technical work in the statistical, social or economic sciences." Thus in so many words is recognized the major principle to secure the recognition of which this Committee was created.

The committees have made no effort to make a detailed study of the allocation of each individual economic, sociological or statistical position to the compensation schedule contained in the Classification Act. To make such a study would necessitate a great amount of time, more than the committees could give without technical assistance, and it involves a question as to whether this Association wishes its Committee to undertake to review the allocations of individual positions not only to see that they are placed in the Economic Analyst Group but also to make sure that they are placed in the proper grade in that group. The Committee is of the opinion that an adequate thorough review would disclose a considerable number of errors which ought to be corrected. It has urged on the Board correction in the cases of the Director and the Assistant Director of the Women's Bureau in the Department of Labor, which were left in the Clerical

Administrative and Fiscal Service. It was able to act in that case because members of the Committee were possessed of the facts warranting the Committee in asserting the technical nature of the work. In this instance the Committee did not go beyond recommending allocation to the Economic Analyst Group. It cannot act in such cases without the assistance of qualified investigators to determine the facts.

The Committee would recommend that it be continued for another year for the purpose of taking such action as may be practicable to bring about the proper classification of economists, sociologists and statisticians. Legislation is pending for the abolition of the Personnel Classification Board and the transfer of its functions to the Civil Service Commission. Passage of this legislation would materially change the situation, and it would apparently be wise to have in existence a committee of the Association on the subject of classification. The Committee, if continued, cannot, however, undertake a detailed study of the classification of economists, sociologists and statisticians unless some provision is made whereby it can have technical assistance in the detailed investigations.

The Committee would recommend that it be continued with the understanding that its action, if any, during the coming year will be dependent on developments in the classification situation.

EDWIN F. GAY, *Chairman*
KATE H. CLAGHORN
MALCOLM RORTY

Report of Committee on Educational and Professional Standards

The Committee met during the spring of this year and outlined two projects—the preparation of a selected list of texts in the several fields of theoretical and applied statistics. This list was published in the September, 1924, JOURNAL of the Association. The Committee is also preparing a questionnaire which will be sent to teachers of statistics in American and Canadian colleges and universities, in order to determine what statistical subjects are taught, what the laboratory facilities are, etc. The Committee hopes to present a report on this subject in time for the March, 1925, number of the JOURNAL. After this latter task is completed, the Committee will take under advisement certain other suggestions which have been made to it during the past year.

JAMES W. GLOVER, *Chairman*

Report of Committee on Fellows, 1924

The Chairman of the Committee on Fellows reports the unanimous vote of his committee in electing the following members as Fellows of the Association, as provided in Article V of the Constitution: Dr. E. B. Wilson, Professor of Statistics in the Harvard School of Public Health, and Dr. J. S. Davis, Economist of the Food Research Institute of the Leland Stanford Jr. University, California.

LEONARD P. AYRES, *Chairman*

PROGRESS OF WORK IN THE CENSUS BUREAU

WEALTH, DEBT, AND TAXATION CENSUS

The census of national wealth, public debt, and taxation has now been completed and the results published in four small paper-covered octavo volumes under the following titles: Estimated National Wealth (34 pages); Assessed Valuation and Tax Levies (150 pages); Taxes Collected (157 pages); and Public Debt (183 pages). In connection with these reports, the Bureau, following precedent, compiled and published a Digest of State Laws relating to Taxation and Revenue, which is a cloth bound volune of 752 pages.

The reports of the last preceding decennial inquiry on this subject, covering the year 1912, consisted of two large cloth bound quarto volumes totalling 1,642 pages. The present reports aggregate 1106 octavo pages. The cost of printing has been reduced from $35,494 for 1912 to $10,309 for 1922. The total cost of the wealth, debt, and taxation census, exclusive of printing, was $219,820 in 1922 as compared with $280,644 in 1912. This reduction in cost has not been effected without some sacrifice of detail. The main difference in the scope of the two census reports is found in the fact that the 1912 report gave a detailed statement of receipts, expenditures, and value of public properties for every county and for every municipality of over 2,500 population, while in 1922 the Bureau, for reasons mentioned in an earlier issue of this JOURNAL (June, 1923), did not undertake to obtain this detail for counties or for cities of less than 30,000 population. The 1922 report, however, shows the receipts from taxes classified under five heads, not only for every city of over 2,500 population, and every state and county, but also collectively for all smaller cities and all townships, school districts, and other classes of political units having authority to levy taxes, thus presenting for the first time a complete total of all direct taxes, Federal, state and local. Meanwhile for cities of over 30,000 population and for states, full detail as to revenues, expenditures, and public properties is shown in the regular annual report on financial statistics of cities and states.

As regards the amount of detail shown for the smaller political units, it is a question whether the Bureau of the Census may not have to make reductions sooner or later in the scope of other reports as well as in that on wealth, debt, and taxation. With the rapid growth of population and consequent increase in the number of cities, the cost of compiling and publishing data for minor civil divisions steadily increases. When the Bureau of the Census took over the annual compilation of financial statistics of cities from the Bureau of Labor 22 years ago, the number of cities of over 30,000 population was 142. Today the number is 248, making that many more cities which have to be visited by the Bureau agents and for which separate statistics have to be shown in the published report. The number of cities of over 2,500 population increased from 2,313 in 1910 to 2,787 in 1920, an increase of over 20 per cent involving a corresponding increase in the cost of any statistical inquiry covering this class of cities. This is something that has to be considered in trying to keep the cost of statistical inquiries within reasonable limits.

CENSUS OF AGRICULTURE

The schedules for the census of agriculture are coming in; the process of editing and card punching is under way; and the Bureau is beginning to issue county press summaries for some of the principal items on the schedule.

Progress has been delayed somewhat by heavy falls of snow and exceptional cold weather in the northern states and floods in some of the southern states. But up to date (Feb. 16) about 750,000 schedules have been received at Washington and between 4,500,000 and 5,000,000 are reported to be in the hands of the district supervisors, who are required to inspect carefully and approve the schedules before sending them forward. This requirement, which is a new feature of the agricultural census, involves some delay in forwarding the schedules, but will, it is expected, save time in the end by reducing the number of follow-up inquiries necessary after the schedules had been received in Washington. The fact that most of the supervisors are either permanent employees of the Bureau detailed for this service, or state statisticians of the Department of Agriculture, or men endorsed by the state agricultural colleges justifies the expectation that their examination of the schedules will be of real value and not merely perfunctory.

CENSUS OF MANUFACTURES

Press summaries presenting the results of the 1923 census of manufactures have been issued for about 350 individual industries, and United States totals for all industries combined were given out February 11, which is about five months earlier than the date of the corresponding publication for the census of 1921. It is of interest to note that the total value of products, after falling off from 62 billion dollars in the boom year of 1919 to 44 billions in 1921, has now come back to a figure in excess of 60 billions, which is about 3 per cent below the peak of 1919.

MONOGRAPHS

The monograph on School Attendance by Frank A. Ross, has just been published, making five monographs issued up to date besides the bulletin of Children in Gainful Occupations, which was originally projected as a monograph. Owing to the reduction in the Bureau's allotment for printing it looked for a time as if it would not be possible to send any more monographs to the public printer before next July. There is now, however, a good prospect of receiving a supplementary appropriation, which will justify the Bureau in sending forward the completed manuscript for two or three additional monographs at an early date. But owing to the length of time it takes to get the reports through the Government Printing Office there will necessarily be an interval of several months before any of these are published.

REVISING BIRTH AND MORTALITY TABLES

Anticipating the necessity for rigid economy in the matter of printing, the Bureau has been planning to reduce the size of the 1923 Birth and Mortality Reports about 33 per cent by cutting out detail. This will be a provisional or temporary measure adopted to provide for an emergency. But the Bureau in the endeavor to produce a model report has under consideration a permanent

revision of tables which may result either in a reduction or an expansion of detail. This, however, is a matter which has been referred to a subcommittee of the Census Advisory Committee for recommendations and on which no final action will be taken without full and careful consideration.

COMMITTEE OF GEOGRAPHERS

Recently with the approval of the Director of the Census a committee of geographers appointed by the National Research Council has been organized to advise the Bureau in matters relating to graphics and geography. The committee consists of Dr. O. E. Baker, Department of Agriculture; Prof. Neven M. Fenneman, University of Cincinnati; Prof. M. S. W. Jefferson, State Normal College, Ypsilanti, Michigan; Prof. A. K. Lobeck, University of Wisconsin, Madison, Wisconsin; and Col. Lawrence Martin, Library of Congress, Washington, D. C. Acting upon the recommendation of this committee the Bureau has under consideration plans for showing the population enumerated at the census of 1920, by physiographic divisions, of which there are 81 as defined by the Association of American Geographers. Then it is further proposed to tabulate for the same divisions some of the agricultural data to be obtained by the current census.

COMPLAINTS FROM BUSINESS FIRMS

The Bureau of the Census receives from time to time complaints from business firms regarding the number of reports that they have to make to different government agencies. With a view to ascertaining how far such complaints are justified and taking steps to secure relief or eliminate any duplication that may be found to exist, the Bureau is trying to ascertain the facts by obtaining from business firms a list of the reports they are called upon to make, with the items of information that they have to furnish. The Bureau will be glad to hear from any business firms that may be interested in this matter.

J. A. H.

MISCELLANEOUS NOTES

Brazilian Census.—The following is a summary of "The Brazilian Census of Population, Agriculture, and Industry taken September 1, 1920," a memorandum laid before the Brussels Session of the International Statistical Institute in October, 1923, by the Brazilian delegate, J. A. Barboze Carneiro.

The census of 1920, carried out under the supervision of M. Bulhoes de Carvalho, Director General of Statistics, is a complete and accurate survey of Brazilian population, agriculture, and industry, the more notable because of the obstacles presented by the size of the country, the inadequate transportation facilities and the large proportion of ignorant peasants.

Enumerations had been made in 1808, 1872, 1890 and 1900. Although the constitution of 1890 provided for a decennial census, none was taken in 1910. On the eve of the one hundredth anniversary of independence the decennial enumeration was reëstablished in a census more comprehensive and accurate than any before attempted in Brazil.

The classifications of the population census were modeled on those used in the United States. There were, however, some differences. The family, instead of the

individual, was used as the enumeration unit, the family being defined as those occupying one house in the case of private dwellings, and as immediate kin in the case of public dwellings. Both *de facto* and *de jure* populations were counted. The inquiry as to color or race was omitted, and the enumeration of physical defects limited to the blind and the deaf-mutes. The director, having already made a special study of the religious organizations, adopted the American practice of excluding questions concerning church allegiance.

The agricultural census gathered data about the occupants of the farm, the nature and extent of the holding, and the products yielded. Information sought concerned: the farmer's name and nationality, legal tenure, mortgages, land improvements, and cultivated and forest acreage; the relative importance of machinery and materials; the number and quality of animals; the production in 1919 of animals, dairy products, and wool; the poultry and bee raising; and the production of cereals, fruit, almonds, coffee, cocoa, cotton, tobacco, Paraguay tea, rubber, other forest products, butter, honey, sugar, wine, brandy, and alcohol. The entire sugar industry was also made the subject of a special inquiry.

The industrial survey gathered information from each industry concerning: the year established, the type of organization, the nature of the exploitive activity, the importance of capital, and of administrative and professional services; the kind, quantity, and cost of raw materials; the annual fuel consumption, the type and capacity of power units, and the quantity or value of the annual product. Certain city services were also investigated. Among these were the slaughtering industry, and the light, water and sewerage systems.

American methods were used in organizing and counting enumeration returns. Equipped with machines similar to those used by the Bureau of the Census, the Brazilians attained a degree of accuracy and speed considered remarkable for inexperienced operatives.

Despite the inherent difficulties of census taking in Brazil, the per capita cost of the investigation was only slightly higher than that of the United States Census of 1910, and was substantially lower than that of Argentina in 1914.

The census law provides that the results for each state and the Federal District be published in separate volumes. In addition to these there are promised four other volumes. The first, an introduction to the census, is already published; it deals with the geography, geology, botany, zoölogy, and the racial social and political institutions of Brazil. The three remaining volumes will treat of the population, agriculture, and industry of the country as a whole.

F. W. NOTESTEIN

Current Business Reporting in Russia.—In view of the general disorganization of Russian economic life, it is particularly interesting to find that there is in Moscow an institution, known by the rather formidable title of Institute of Economic Conjuncture, which issues reports on current business conditions in Russia similar to those published in this country by the Department of Commerce and the Federal Reserve Board. The Institute issues a monthly economic bulletin in which index numbers of prices, money in circulation, production, trade, transportation, and labor conditions are presented. In addition to the individual indexes, the Institute undertakes to construct a combined index of business conditions which it calls the barometer of economic conjuncture. This index is an average of the individual indexes and is expressed as a percentage of the average for the period January to March, 1923. In addition to current figures the bulletin contains articles on various phases of economic development. The director of the Institute and the editor of the bulletin is

Professor N. D. Kondratieff, who teaches economics in the University of Moscow. The Institute is supported in part by the university and in part by the government.

The government's interest in the Institute arose at the time when the value of paper money fluctuated so violently that it was imperative to have some measure of these fluctuations in order to have a basis for financial estimates, even for the shortest period in advance. By being able to meet the government's requirements for current statistics Professor Kondratieff succeeded in obtaining the necessary support for his Institute. The *Economic Bulletin* appears to represent careful work, done in accordance with modern ideas of statistical technique, and is an extremely valuable source of information on Russian economic developments.

E. A. G.

International Union for Scientific Research.—On the occasion of the International Congress on Social Policy held at Prague from October 1 to 4, 1924, a group of economists decided to found an International Union for Scientific Research in Social Economics to foster coöperation between all countries in the development of an independent science of Economics based on observation of the facts. Particular attention will at first be paid to the progress of the labor movement, the growth of industrial democracy, and of international "solidarity."

Centers have been established provisionally by the new association at Berlin, Cambridge, Paris, and Rome. The constituent committee includes the following names: S. Bauer (*Bale*), C. Bouglé (*Paris*), P. Sargant Florence (*Cambridge*), C. Grünberg (*Francfort*), R. Kutchinsky (*Berlin*), A. Loria (Senate, *Rome*), N. Reichersberg (*Berne*), C. Rist (*Paris*), R. H. Tawney (*London*).

The Employment Clearing House of the Statistical Association is now in full operation. At present, ten members have registered as desiring better positions and a considerable number of others have signified their intention of so doing. A number of employers have already filed requests for assistance.

It is hoped that a large number of the members of the Association will register in the near future, as it is the intention of the Secretary to start a campaign among employers as soon as a sufficient number of persons register to justify such action.

At present, there appears to be a demand for a considerable number of young men just out of college who have had satisfactory statistical training. It would seem that teachers of statistics might well suggest to their classes the desirability of membership in the American Statistical Association and the possibility of obtaining employment by making use of the services of the Clearing House. It is believed, also, that we will be able to render material assistance to those in search of teaching positions in statistics.

The effectiveness of coöperation between the Joint Committee of the American Statistical and American Economic Associations with the Director of the Census, is noted in the following paragraph from a recent Census Report of the Dominion of Canada:

> "In Great Britain and the United States the census offices in framing their schedules and regulations had the assistance of advisory committees appointed respectively by the Royal Statistical Society of Great Britain, and by the American Statistical and Economic Associations. In the United States, fourteen meetings of the Committee were held in conjunction with the census authorities and a series of ninety-three resolutions were passed, each bearing on an important point of procedure. The general similarity of conditions in the United Kingdom, the United States and Canada, has rendered the reports and recommendations of these committees of material value to the Dominion Bureau of Statistics."

OTTO R. EICHEL

Dr. Otto R. Eichel died at Geneva, Switzerland, December 24, 1924, in his forty-second year. Soon after receiving his degree of M.D. in 1906 he began work at Buffalo in the campaign against tuberculosis and in 1917 accepted a position at Albany succeeding Dr. Cressy L. Wilbur as director of vital statistics in the State Department of Health. He quickly acquired a mastery over this field and contributed greatly to the prominence and prestige in it which the state had rapidly built up under his predecessor. Early in 1924 the State Department of Health was persuaded to grant him an extended leave of absence so that he might aid the Health Section of the League of Nations in improving its statistical work. In this task he had proved very successful and to it in a real sense he gave his life. In his death American vital statistics has suffered a heavy blow. He was second to none among us and all his friends felt that he was on the threshhold of still larger achievements.

GEORGE CHANDLER WHIPPLE

George Chandler Whipple died at his home in Cambridge. He was Professor of Sanitary Engineering at Harvard University, and for the last twenty years had been a member of the New York firm of Hazen and Whipple, consulting engineers, 25 West Forty-third Street. He was at one time Chief of the Department of Sanitation for the League of Red Cross Societies, and during the World War served on a special Red Cross Commission in Siberia and Russia. More recently he had been a member of the State Board of Health in Massachusetts. Among his books on sanitation the best known is *The Microscopy of Drinking Water*. He was born in Boston in 1866, and graduated from the Massachusetts Institute of Technology in 1889.

CHARLES W. LIPPITT

Charles W. Lippitt died in April, 1924. He was Governor of Rhode Island, 1895–7. He was born in 1846, and has been President of the Providence Board of Trade, and Vice-President of the United National Bank. He has been a Life Member of the American Statistical Association since 1906.

H. W. ST. JOHN

H. W. St. John died in September, 1924. He was an actuary with the Aetna Life Insurance Company of Hartford, Conn. He has been a member of the American Statistical Association since 1903.

Dr. Armand Julin, Secretary General of the Ministry of Industry, Labor, and Social Welfare of Belgium, the most recently elected addition to the list of honorary members of the American Statistical Association, was awarded on December 4, 1924, the Heuschling quinquennial prize of 7,000 francs for his noteworthy two-volume contribution to statistical science, entitled *Principes de Statistique Théorique et Appliquée.*

Dr. L. W. Hatch resigned the position of manager of the State Insurance Fund in the New York State Department of Labor on January 1, 1925, and was appointed on the same date director of the Bureau of Statistics and Information in the same department, with office at 124 East 28th Street, New York City.

Mr. Lawrence B. Mann, until recently in charge of the section on business conditions in the United States in the Division of Research and Statistics of the Federal Reserve Board, has resigned to become assistant chief of the Division of Statistical Research of the Bureau of Foreign and Domestic Commerce.

Miss Margaret Loomis Stecker, of the research staff of the National Industrial Conference Board, has been on leave of absence from the staff since December 1, 1924.

M. C. Rorty, vice-president of the International Telephone and Telegraph Corporation and president of the International Telephone Securities Corporation, has been abroad for over a year, and has also been traveling in South America in the interests of the International Telephone and Telegraph Corporation.

Presentation of Silver Service to Professor and Mrs. Robert E. Chaddock.—A large group of members of the Association had felt the desirability of showing in a fitting way their appreciation of the devoted and efficient service rendered to the organization by Professor and Mrs. Robert E. Chaddock. This feeling crystallized into a movement to express the idea in tangible form.

The culmination of this movement was a gathering, on the evening of January 15, at the home of Professor and Mrs. William F. Ogburn, at which took place the presentation to Professor and Mrs. Chaddock of a sterling silver tea set in Colonial pattern.

After interesting reminiscences by Dr. W. S. Rossiter and Prof. Franklin H. Giddings concerning events in Professor Chaddock's career, the presentation was made by Dr. Louis I. Dublin.

The reading of letters from absent members, expressing appreciation of the services of Professor and Mrs. Chaddock, closed the program.

W. I. King.

To the Editor of the Journal of the American Statistical Association.—May we express, through you, our deep appreciation to the members of the American Statistical Association for their very kind thoughts and for the delightful surprise of the silver tea set.

These years of work and friendliness together have given to us so many interesting and pleasant associations that we do not feel we deserve so beautiful a gift, but we are very proud you have thought of us in so graceful a way and we are immensely pleased whether we deserve it or not. Please accept our sincere thanks.

Rose A. Chaddock
Robert E. Chaddock

APPOINTMENTS, 1925.

Editor—William F. Ogburn.

Associate Editors—Edmund E. Day, James W. Glover, Wesley C. Mitchell, Frank Ross, Leo Wolman.

Assistant Secretaries—James A. Field, Chicago; A. J. Hettinger, Jr., Boston.

District Secretaries—Hornell Hart, Bryn Mawr; Dorsey W. Hyde, Jr., Washington.

Committees, 1925.

Joint Advisory Committee on the Census—W. S. Rossiter (Chairman), R. E. Chaddock, S. L. Andrew.

Committee on Finance—Edmond E. Lincoln (Chairman), F. Leslie Hayford, Willford I. King.

Membership Committee—Edwin W. Kopf (Chairman), Arthur R. Burnet, James A. Field, Hornell Hart, A. J. Hettinger, Jr., Dorsey W. Hyde, Jr., Prof. A. H. Mowbray, Jessamine S. Whitney.

Committee on Governmental Labor Statistics—Mary Van Kleeck (Chairman), A. J. Altmeyer, Charles E. Baldwin, Joseph A. Becker, W. A. Berridge, W. R. Burgess, R. D. Cahn, R. H. Coats, Frederick E. Croxton, J. F. Dewhurst, Ralph G. Hurlin, Don D. Lescohier, M. O. Lorenz, Eugene B. Patton, Roswell F. Phelps, Walter W. Stewart, Woodlief Thomas, F. G. Tryon, Leo Wolman.

Committee on Institutional Statistics—Horatio M. Pollock (Chairman), Edith Abbott, Kate H. Claghorn, Edith M. Furbush, Joseph A. Hill, Robert M. Woodbury.

Joint Committee on Standards for Graphics—Karl C. Karsten (Chairman), Howard W. Green, Arthur H. Richardson.

Committee on Educational, Scientific and Professional Standards—James W. Glover (Chairman), Leonard P. Ayres, W. A. Berridge, E. W. Kopf, Edmond E. Lincoln, Malcolm C. Rorty.

HONORARY MEMBERS

At the invitation of the Board of Directors the following persons distinguished internationally in the development of statistical methods and their applications in different fields of scientific endeavor have accepted honorary membership in the association:

Prof. A. L. Bowley, London School of Economics, London, England.

Dr. John Brownlee, National Institute for Medical Research, Mount Vernon N. W. 3, London, England.

Prof. C. V. L. Charlier, University of Lund, Sweden.

Prof. Corrado Gini, University of Padua, Padua, Italy.

Mr. Major Greenwood, Hillcrest, Church Hill, Loughton, Essex, England.

Prof. G. Udny Yule, St. Johns College, Cambridge, Mass.

Prof. Karl Pearson, University College, Garner St., London, England.

The American Statistical Association deems it an honor to welcome these new members.

MEMBERS ELECTED SINCE DECEMBER, 1924

Banks, Gordon T., Federal Reserve Bank, Boston, Mass.

Batschelet, Clarence E., Bureau of the Census, Dept. of Commerce, Washington, D. C.

Billings, Franklin O., Western Electric Co., 195 Broadway, New York City.

Bowers, Glenn A., Industrial Relations Staff, Curtis, Fosdick & Belknap, New York City.

Boyajian, Aram, General Electric Co., Pittsfield, Mass.

Browne, Harold F., National Industrial Conference Board, 247 Park Ave., New York City.

Bunzel, Miss Bessie, Metropolitan Life Ins. Co., New York City.

Burritt, Bailey B., New York Association for Improving the Condition of the Poor, 105 E. 22nd St., New York City.

Butler, Miss Clara W., Pennsylvania Tuberculosis Society, Hotel Titlow, Uniontown, Pa.

Byrne, Lee, 416 W. 122nd St., New York City.

Chapman, Florence A., The Van Sweringen Co., 1200 Marshall Bldg., Cleveland, Ohio.

Clark, Percy L., Jr., Dept. of Economics, Cornell University, Ithaca, N. Y.
Cowan, Donald Ross, College of Agriculture, University of Missouri, Columbia, Mo.
Daugherty, M. M., Agricultural and Mechanical College of Texas, College Station, Texas.
Davies, G. R., University of North Dakota, Grand Forks, N. Dak.
Dempsey, Mary V., Syracuse Health Demonstration, 314 E. Fayette St., Syracuse, N. Y.
Diederich, Alfred L., Bureau of Statistics and Inspection, New Jersey State Dept. of Agriculture, Trenton, N. J.
Edgerton, Edward I., Wm. L. Dickinson High School, Jersey City, N. J.
Ezekiel, Mordecai, J. B., Bureau of Agricultural Economics, Washington, D. C.
Fossum, Paul R., Wesleyan University, Middletown, Conn.
Frankel, Miss Anna, 2495 Marion Ave., New York City.
Frankel, Emil, Dept. of Welfare, Harrisburg, Pa.
Fredenburg, Ford Webster, 1 Couper St., Kingston, Ont., Canada.
Gorringe, Mary May, University of California, Berkeley, Calif.
Green, James A., Standard Oil Co. of Indiana, Detroit, Mich.
Greeson, James C., Southwestern Bell Telephone Co., St. Louis, Mo.
Helmle, William C., American Telephone & Telegraph Co., 195 Broadway, New York City.
Holland, Dorothy F., American Child Health Association, 370 7th Ave., New York City.
Kerr, Paul S., Clark Estates, 149 Broadway, New York City.
Kuznets, Simon S., Columbia University, New York City.
Leinig, Edward, The North American Co., 60 Broadway, New York City.
Leisy, Miss Agnes, State Charities Aid Assn., 105 E. 22nd St., New York City.
LeRoy, Miss Maude, 5055 Sheridan Road, Chicago, Ill.
Lindholm, S. G., Chamber of Commerce of the United States, Washington, D. C.
Mallory, Edwin P., Canadian National Railways, McGill St., Montreal, Canada.
Matz, Herman L., S. S. Kimbell Brick Co., Chicago, Ill.
Oakley, Thomas, The T. Eaton Co., Ltd., Toronto, Ont., Canada.
Peabody, Walter R., Rutgers College, Brunswick, N. J.
Rhodes, Herbert W., The Mutual Benefit Life Ins. Co., Newark, N. J.
Riley, Edmund J., Edison Lamp Works, Harrison, N. J.
Rosenberg, Miss Rena, Children's Bureau, Dept. of Labor, Washington, D. C.
Sievers, Edward G., Treasury Dept., Income Tax Unit, Engineering Division, Washington, D. C.
Stein, Edward T., U. S. Bureau of Public Roads, Division of Highway Economics & Motor Transport, Washington, D. C.
Sterns, Fred H., Amer. Tel. & Tel. Co., 195 Broadway, New York City.
Stitts, T. G., University of Minnesota, Minneapolis, Minn.
Stryker, Henry B., New York Telephone Co., 15 Dey St., New York City.
Walker, Q. Forrest, R. H. Macy & Co., Inc., New York City.
Washburn, Helen M., Harvard University Committee on Economic Research, Cambridge, Mass.
Washing, Carleton I., 5 West 125th St., New York City.
Wennstrom, John M., Hudson Insurance Co., 75 Maiden Lane, New York City.
Weston, N. A., University of Illinois, Urbana, Ill.

REVIEWS

The Hospital Situation in Greater New York. New York Academy of Medicine (Lewinski-Corwin). New York: Putnam, 1924.

Conceived in a broad and generous spirit, developed by thorough and accurate first-hand studies, expressed with precision and yet with imagination and distinction, this report of the Committee on Public Health of our Academy of Medicine represents a type of community effort at self-analysis as rare as it is valuable.

As was to have been expected from the author of the report, E. H. Lewinski-Corwin, Ph.D., the secretary of the committee since its organization, the economic and statistical presentation of the picture is sufficient and free from error.

Orderly and sound, this book, far more than a set of facts for New Yorkers alone or hospital boards and superintendents chiefly, is as wide in its application and appeal as is the whole problem of joint housekeeping for the sick the world round.

If one were to wish for any change in the sequence of chapters it would be to advance Chapter III to first place to deal with the estimated need for hospitals before embarking on the story of New York's ancient efforts and errors.

What costly mischief might not have been avoided by Uncle Sam in his pitiful blundering with post-war hospitalization of ex-service men if his administrators had learned the lessons this book so clearly offers, that a hospital bed may be useful or not according to the types of service and the demands of the traffic of the sick.

Entirely aside from New York's unwelcome eminence in mere bulk of people, the accomplishment of the city government and its citizens in providing 10 per cent of all the hospital beds of the country is worthy of praise; and one will go far to find any expenditure of $35,000,000 for other purposes so well gauged to the needs of a community as is this annual bill for upkeep of the 32,000 beds now in commission in the Greater City of New York.

Of the total ratio of 5.7 hospital beds for each 1,000 of the population, the city government has given a larger share than is usual in our cities—39% of the total hospital capacity being in tax supported municipal institutions, 57% in privately endowed, non-commercial hospitals and 4% in proprietary institutions.

A fair comment upon the relative desirability, efficiency of management and value of public and private ownership and operation is the precentage of use of beds throughout the year, the city hospitals recording only 67.3% of capacity availed of by patients while 73.2% of the possible bed days were used in the privately controlled institutions.

Throughout the volume there are many side lights and indices of changing social and economic conditions, as for instance the note that from 1911 to1922 the percentage of patients who paid the cost of their hospital care rose from 18% to 45%; and this is the more remarkable since this same period was marked by an increase in hospital costs of about 100%.

The omission of a chapter on the dispensary as an integral part of a modern community hospital is explained by the desire not to repeat already published material, but it would have added greatly to the value and completeness of the subject of public care of the sick to have the details of out-patient services between the same covers.

One searches in vain for any reference to that essential professional addition to hospital care, the hospital social service. It is true that an article of considerable extent appeared under the same authorship, "Medical Social Service in Dispensaries," in the *New York Medical Journal* January 8 and 15, 1921, but even this useful contribution fails to describe the need and extent of social service in hospitals, the results to the patients, the importance to diagnosis and treatment, the appreciation of this new resource by medical staff and its effect on the whole fabric of hospital administration.

The progress of physicians in their science and art depends so much upon continued contact with hospitals and dispensaries that we note with some satisfaction the very high proportion of all physicians in the greater city who have hospital affiliations, 36.8%: a much larger percentage than is found generally in other cities. The effectiveness of medical service is revealed also in a measure by a study of the number of hospital beds per staff or attending physician, in the Borough of Brooklyn the ratio being 6.6 beds per doctor.

After observing the very heavy load carried by the hospitals of some other cities in caring for nonresident patients, as for instance 25% of all hospital beds in Louisville, Ky., being occupied by out of town patients, New York's estimated load of 5% seems very moderate and hardly accounts for more than the usual transient or nonresident population in our hotels, and allows little for the patients from the suburban and rural areas of adjacent states.

One is more than ever impressed with the necessity of placing the financial costs of sickness ultimately upon the well and not upon the sick. Unless people in health, by hospital memberships, as in Sheffield, England, or by annual payments to clubs, as in Havana, Cuba, or by premiums of an insurance or mutual or cooperative nature, invest in the institutions which will harbor and care for them in sickness, the burden of hospital costs will continue to seem unbearable by the majority of the sick.

The actual instances of hospital costs, by disease, by institution, and according to duration of illness, together with the scale of prices for beds, rooms and special services, are illuminating, and if understood as well by the healthy as by the sick, should lead to a more systematic financial safeguarding against sickness dependency.

In this connection it is worth pointing out that one element of sickness costs not analyzed or reported upon in this otherwise comprehensive study is the true, minimal or maximal cash value of the services given to the multitude of free hospital and dispensary patients by the visiting physicians and surgeons. From a study of a dozen hospitals in New York within the past few years, it appears that the contributions by the laity to meet the cost of giving free service to the indigent sick in hospitals and dispensaries does not equal the sum represented by the most modest estimate of the medical services given by the attending staff.

From experience in other cities it might be said that 22 maternity patients per year per bed rather than 30 should be a basis of practice, and it was apparently not known to the author that in Minneapolis and San Francisco 65% of births are in hospitals. We are in New York probably less well provided for maternity cases in hospitals than would appear. Certainly the trend of the past 15 years has been strongly towards hospital confinements.

An instance of most useful tabulation, helpful far and wide to hospital boards and invaluable to the disciples of good hospital administration who go from city to city trying to raise standards of practice, is the table of distribution of maintenance expense by twelve fundamental classes, dealing as it does with an annual outgo of over $20,000,000 for a four year period (pp. 106–107).

Several volumes could be added to deal in greater detail with per capita accounting, perpetual inventories, departmental segregation of costs, uniform rates to cover all items now charged for separately, the cause and origin of hospital surpluses, but there are two chapters of such outstanding merit that we should not cavil at minor omissions. Chapter VII on the Nursing Situation and Chapter VIII on Medical Records are so full of meat and so stimulating to action that doctors and nurses alike should pay tribute to the accuracy and courage of the report.

If for nothing else, the chapter on nursing would be notable for its analysis of the actual nursing time spent in 24 hours for each patient. The detailed studies of duration of particular routine duties such as giving of baths and taking of temperatures reveals the wide variations in technique and time.

Application of this method to several hospitals in another study has shown that probably a better basis of comparison would be the nursing hours per patient per week or month rather than per day because of the cycle of day and night duties and schedule of days on and off duty of nurses in training.

No one who deals in morbidity or mortality data can afford to miss the chapter on hospital records. It is hard indeed to retain any confidence in published reports of diagnosis and results while reading of the extent to which incompleteness and neglect characterize hospital records. This chapter represents a most conservative and carefully edited statement and while reading the following quotations we, prospective hospital patients, must remember that medical care is more nearly complete and adequate than are the records of medical observations.

> It is, for example, of no little import to find that in both complete and incomplete records, only one case history in three is measurably adequate, or that only one record in ten has a statement showing an examination on discharge; that, as far as the records show, two-fifths of the ward patients are examined by no one but the intern; that only 60% of the diagnoses of malignancy are confirmed by laboratory tests, and that in one case out of every four the nurses' entries are the only clue to the progress made between admission and discharge.

Eight per cent of the 752 case histories studied had no history recorded; 12% contained no record of physical examination on admission.

> For instance, brief notes were found in 29% of the cases of syphilis, 36% of chronic interstitial nephritis, 34% of diabetes, and 61% of acute appendicitis cases; brief notes were also made in 1 out of 3 cases of typhoid fever, 2 out of 7 cases of ulcer of the stomach, and 1 out of 2 cases of acute general tuberculosis.

In 22% of the cases studied there was no record of a provisional diagnosis.

> . . . 35% of the cases studied in one hospital had no provisional diagnosis recorded while in three hospitals a provisional diagnosis was recorded in every case.
>
> Thirty-one per cent of acute rheumatic fever and 31% of exophthalmic goitre cases had no provisional diagnosis; 28% of hernia and 28% of syphilis; 18% of chronic cardiac valvular disease and 17% of acute appendicitis had no provisional diagnosis; 13% of chronic interstitial nephritis; 11% of lobar pneumonia and four out of nine cases of acute cholecystitis lacked the recording of a diagnosis.

We can take some comfort however, from the fact that a final diagnosis was recorded in every case although only in 87% of the instances was this final diagnosis supported by the case record.

When death certificate stubs were compared with final diagnoses, many discrepancies were discovered.

> Autopsies were performed in 55 cases; in 64% of these the final diagnosis and autopsy diagnosis essentially agreed. In 26% additional conditions were found at autopsy which were not diagnosed before death; many of these were not revealed by the clinical course of the disease as far as the record indicated or by any laboratory reports. About 10% did not agree with the final diagnosis. The important fact is again pointed out that final diagnoses are frequently not corrected to conform to autopsy findings when there does not seem to be sufficient reason for disputing the latter. Autopsies were performed in 24% of the cases studied which had a fatal termination; this average is higher than the general average for all hospitals. The antiquated law of the State pertaining to autopsies acts as deterrent to scientific progress.
>
> Twenty-three per cent of the cases had no bedside or doctor's progress notes whatever.

The greatest source of error in diagnosis is known by all teachers of clinical medicine to be the failure to make a complete medical examination in every case and yet we find the following doubtless well supported statement in the report.

> The findings indicate that local examinations are made more often than general ones. Many of the patients did not receive a general physical examination at any time during their stay in the hospital.
>
> General physical examinations averaged about one to every three cases. Chest examinations stood highest for local examinations with one to every 1½ cases. Abdominal examinations with an average of one to about every five cases were next in order of frequency.

From study of the records of laboratory tests we find that in only six of the 21 general hospitals from which records were studied, was a urinalysis reported in every case.

> One patient with diabetes was in the hospital five days before any urinalysis was made, according to the record; the findings of this examination showed the presence of sugar, acetone and diacetic acid but no further urinalyses were recorded although the patient was in the hospital two weeks longer. Another diabetic patient was in the hospital ten days before any urinalysis was made, according to the record. One case with a diagnosis of lumbar abscess was in the hospital 85 days and had only one urinalysis recorded during that time. Another patient with general arterio-sclerosis had only one urinalysis during a stay of 43 days.

One source of information as to the quality and end results of hospital care which might with advantage have been applied in New York as it has been in Cleveland, Brooklyn, San Francisco and Louisville is the convalescent study or

inquiry by home visits into the actual conditions of patients recently discharged. Hospitals still live chiefly or wholly an intramural existence and in spite of the expansion of the hospital as a public service institution there remains much to be done in the way of integrating the hospital episodes of ill health with those of the home, with the care of the private practitioner, of the visiting nurse, of the social service visitor, of the convalescent home, and of the home for chronics and incurables.

We close the book with a sense of pride and humility, pride in the workmanship and in the courage of expression, humility in the revelations of our partial accomplishment and the serious omissions of our community services for the sick.

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The Mathematical Groundwork of Economics, by A. L. Bowley, Sc.D., F.B.A., Oxford: Clarendon Press. 1924. Pp. viii, 98.

The readers of this JOURNAL are familiar with Professor Bowley's high attainments in the field of statistics. His latest book reveals him as an adept in the difficult field of mathematical economics. He has attempted, he tells us, "to reduce to a uniform notation and to present as a properly related whole, the main part of the mathematical methods used by Cournot, Jevons, Pareto, Edgeworth, Marshall, Pigou, and Johnson, so far as these are applied to the fundamental equations of exchange and to the elementary study of taxation."

In this attempt, there is no room for doubt, Professor Bowley has been successful. His book is the one best guide available to the student who seeks to acquaint himself with the methods and results of modern mathematical economics. For this purpose it is vastly better than books *about* mathematical economics, such as those of Boven and Moret. Up to now, Zadwadski's able work, *Les Mathématiques appliquées à l'économie politique*, has afforded the best general survey of the field, but Professor Bowley's book is broader in scope and more systematic. Further, Professor Bowley is the first to weld the scattered parts of mathematical economics into a consistent whole. His modest disclaimer of intent to advance new theorems in economics should not be permitted to obscure the distinctly fresh and original quality of his own contribution. To relate two previously unrelated theorems is, in effect, to advance a new theorem. No small amount of pains and skill has gone into the making of this book.

As an example one may take Professor Bowley's successful synthesis of the type of analysis which employs utility surfaces, indifference curves, and the like (*e. g.*, Edgeworth, Fisher, Pareto), and the type of analysis which is concerned with the supply and demand of particular commodities as related to money prices (*e. g.*, Cournot, Marshall). In this way the limiting assumptions implicit in the latter type of analysis are brought into clear relief. Here as elsewhere the book affords striking illustrations of the principal and possibly the only advantage mathematical constructions have in economics. Professor H. L. Moore has put the point admirably: "Attempts at symbolic precision precipitate the assumptions tacitly

and unconsciously made in ordinary reasoning." Or, one might say, the mathematical method supplies to economic theory a highly important critical apparatus.

One advantage commonly attributed to the mathematical method, namely, that it alone affords a view of the whole economic structure, seen rightly as a system of interdependent variables, obviously is not a separate advantage. It is covered by the more general advantage already indicated. So far as my knowledge goes Professor Bowley is the first English economist who has attempted to define the general conditions of economic equilibrium by sets of interdependent equation. At this point, and, it appears, at this point only, has Professor Bowley drawn upon Pareto. But Pareto's own system, in its later stages, came to be virtually a blend of Walras, Edgeworth, and Fisher, with certain arid generalizations added. Professor Bowley's handling of the matter is better than Pareto's, notably so in the case of production functions.

A serious doubt respecting the significance, not so much of mathematical economics *per se* as of the type of economic theory which lends itself best to mathematical formulation, is suggested by the difficulty of defining the function that bears the same relation to the preferences of consumers as profits do to the decisions of entrepreneurs. Pareto finally contented himself with an abstract "function-index of choice." Professor Bowley's procedure involves, (1) an algebraic function of measurable quantities of economic goods, and (2) a non-measurable function expressing the "satisfaction" derived from such goods, related to the first function by the general condition that their first derivatives shall have the same sign, and, for certain theorems, by the further condition that their second derivatives also shall have the same sign. Professor Bowley is within his rights when he calls the first function a "utility function." But I think he goes too far when he says, "The utility to which it relates is that generally called utility or value in exchange." And he is less than circumspect when he suggests that the second function denotes "the satisfaction derived from economic goods," or "in some cases the desire to obtain them." There is all the difference in the world between these two notions. But it is unfair to blame Professor Bowley for not straightening out a matter which a whole generation of economists has done its best to confuse.

Professor Bowley ventures only the briefest of allusions to consumers' surplus. His precautions at that point appear to me to be almost but not quite sufficient. With respect to another vexed question, the problem of duopoly, Professor Bowley holds with Edgeworth and Pareto that the problem is indeterminate, depending on what each producer thinks the other is likely to do. This conclusion seems to imply a particular premise with respect to the *degree* to which each producer takes the other's probable policies into account. Another assumption, quite as reasonable, leads to the conclusion that, if the cost curves of the two producers are alike, the price, *without* combination, will be fixed at the point where it would be put by a monopolist who could produce $2x$ units at just twice the cost incurred by either competitor in producing x units. The problem involves analysis very much like that with which Poe amused himself in his story of "The Purloined Letter."

A summary of the mathematical principles used in the book is compressed

onto an appendix of nineteen pages. This summary, Professor Bowley suggests, is "only likely to be useful to those who have at some time studied the elements of the calculus in an ordinary course." To such, however, it is likely to prove very serviceable.

ALLYN A. YOUNG

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The Problem of Business Forecasting. Papers presented at the Eighty-Fifth Annual Meeting of the American Statistical Association, Washington, D. C., December 27–29, 1923. Edited by Warren M. Persons, William Trufant Foster and Albert J. Hettinger, Jr. Boston: Houghton Mifflin Company. 1924. Pp. vii, 311. (Number Six, Publications of the Pollak Foundation for Economic Research.)

Of the papers presented at the annual meeting of the American Statistical Association in Chicago in 1922, but three are preserved in the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION. Possibly others found publication elsewhere. Nevertheless, the bulk of the material prepared for such meetings reached only those persons present when the papers were actually read. These papers should represent in large part the advance of the science. They should afford a significant index of the best that statisticians have done during the year. It is therefore of considerable importance that the Pollak Foundation has seen fit to include among its publications a volume containing twenty-one papers presented before the American Statistical Association in Washington in 1923.

The general subject with which all these papers deal is the problem of business forecasting. The fields of business activity definitely represented are mercantile trade, transportation, manufacturing, construction, mining, agriculture and foreign affairs. Strangely enough, the field in which statistics were first used extensively, banking, is not included, nor is the favorite playground of business forecasters, the stock market.

The papers in the different fields follow no uniform course. A few are theoretical; some present new data or restate old material; some report on old forecasts or venture to make new ones. There is even the often-heard wail for more data.

The most significant matter of statistical theory appearing in the volume is the caution expressed in several chapters concerning the use of the correlation coefficient. In the presidential address, "The Problem of Business Forecasting," Professor Persons admits the value of the correlation coefficient as a means of describing phenomena for any given period. However, Professor Persons holds that the mathematical theory of probability cannot provide a basis for the purpose of forecasting. The new year is not a random year. "Granting as he [the statistician] must, that consecutive items of a statistical series are, in fact, related, he admits that the mathematical theory of probability is inapplicable." One must forecast rather "by the application of the usual methods of [inductive] argument."

A specific warning against the use of the correlation coefficient appears in "Forecasting Crops from Weather Conditions," by J. B. Kincer. Mr. Kincer

finds the problem complicated far beyond the conditions required for the use of the Pearsonian coefficient by such conditions as: 1, the relation between crops and weather may not be a linear one; 2, rainfall data are not distributed about the mean in a normal frequency; 3, crops are not in the same stage of development each year at the same period in the year; 4, the intensity of rainfall may vary although the total amounts be equal.

The fact that these papers were presented orally made the inclusion of large amounts of numerical data impossible. However, some new series of importance are to be found in the volume. Among these are:

Wholesale Trade Index. Annually, 1909–1919. (King)
Retail Trade Index. Annually, 1909–1919. (King)
Index of Tonnage Originating. Annually, 1899–1923. (Peabody and Friday)
Coke Production. Monthly. Beehive, 1912–1914. By-Product, 1912–1916. Total, 1912–1923. (Smith and others)
Cement Production, Shipments, Stocks. Monthly, 1911–1920. (Smith and others)
Coal, Anthracite, Production. Monthly, 1911–1912. (Smith and others)
Costs and Profits, Coal Operators and Coal Wholesalers. Annually, 1913–1922. (Wing and Tryon)

In addition to these specific series, there are excellent reviews of the data available in mining, construction, and foreign affairs. The chapter "Fluctuations in Mineral Output," by George Otis Smith and others, discusses the more important minerals in terms of their value as business barometers, but includes with each a memorandum of the pertinent sources. The belief is expressed that as the series recording electric power production grows longer, it will become one of the leading indicators of business conditions. A more intimate picture of the nature of unofficial metal statistics is presented in the chapter "Available Metal Statistics" by F. E. Wormser and E. H. Robie.

The statistical series which are now available for use in the analysis of construction, are thoroughly criticized by W. C. Clark in "Forecasting Building Construction" and in a discussion contributed by John M. Gries. Mr. Clark uses building permits as the basis for his study, while Mr. Gries finds permit data helpful only in showing the trend over a long period. Both might agree that, although building permits do forecast construction, they cannot be taken as an index of building activity.

A brief but comprehensive statement concerning sources for foreign statistics appears in "Forecasting Conditions in Europe" by Joseph S. Davis.

In accordance with the best practise, most of the writers avoided the making of definite forecasts about the future. Although it may be contrary to the "ethics of the profession," the reviewer has checked the six definite forecasts which are made in the book. Unnaturally, they have all been justified by later events. Mr. Prescott predicted automobile production to be between 2,700,000 and 3,300,000 passenger cars in 1924. The total produced to December 1, was about 3,000,000 with December promising less than 200,000. Mr. Clark predicted that 1924 would be a high year for construction, and contracts awarded to December 1, exceeded all previous records by 13 per cent. Mr. Pogue predicted a probable decline in crude-oil output in 1924. The decline, though slight, has occurred, the peak being reached in October, 1923. Mr. Wallace's prediction for the price of

hogs was within 1½% per cent of that realized. The errors in the prediction concerning European affairs made by Joseph S. Davis are surprisingly slight, considering that one of the stated assumptions of the forecast was that no reparations settlement be reached. The general forecast by Professor Hardy with which the book closes, is accurately descriptive of 1924, although the decline seems to have been more severe and more protracted than the forecast implies. This is as accurate forecasting as anyone could wish, and speaks well for the progress which business forecasters are making.

From this collection of studies, it is possible to gain at least an impression of the statistical methods now current. For determining trends, the straight line seems to be the favorite curve. Dr. King makes use of the moving average, Mr. Prescott uses Gompertz' curve, and Mr. Pogue employs two compound interest curves. Otherwise, the straight line has a clear field. In many cases, this is justified either by the actual form taken by the original data or by the shortness of the period. In many other instances, it proves not only unsatisfactory but misleading. This is unfortunately well illustrated in the paper on "Fluctuations in Railway Traffic." A straight line is fitted to revenue ton-miles for the period 1890–1923, and deviations from this straight line are called deviations from "normal." The result is that at the two ends of the period, the deviations are far above normal, and in the middle, are below. If the normal used is correct, then revenue ton-miles were below normal nearly all the time from 1894 to 1915, despite the fact that many of the intervening years were prosperous. This procedure also magnifies the 1904 relapse to a depression as deep as those of 1897 or 1921, and much more severe than that of 1908. If the straight line had been fitted to the logarithms of these data, the results would have been quite different, and much nearer the truth.

The present bewilderment under which many of us suffer concerning the nature and method of removal of seasonal fluctuations is also reflected in this volume. At least six different methods are reported to have been used, but little attempt is made to justify the particular methods or to explain just what they have accomplished. It is conceivable that there may be a number of different methods whereby such corrections can best be made, each fitted for use under certain conditions, just as there are different families of curves which may be used for removing trends. However, the only real contribution to the solution of this problem is contained in the chapter "Forecasting Automobile Production" in which the change in the industry itself, namely, the increasing importance of closed cars, necessitated the use of a changing seasonal. This same procedure has been independently developed and methods suggested by Dr. King in the September number of this JOURNAL.

One further matter of technical interest is that all corrections for value changes were made by means of specially prepared index numbers. This would seem to indicate a tendency away from the use of the general index number of wholesale prices for the purpose of correction, towards the use of indexes which can be logically defended on grounds other than of immediate availability.

With little hesitancy, the reviewer feels able to forecast a place in our best statistical literature for this volume. In spite of the already overwhelming

burden of books to be read, it is certainly to be hoped that the Pollak Foundation will continue to gather together for many years the papers read before the American Statistical Association and preserve them in as attractive form as that of the present volume.

WILLARD L. THORP

National Bureau of Economic Research

The Tax Problem in Wisconsin. National Industrial Conference Board. 1924. Pp. 163.

It seems that the Wisconsin Manufacturers' Association made a mistake when it turned down a proposition to conduct a joint investigation, along with representatives of farmers, laborers and professional men, of Wisconsin's tax system and then invited an outside agency to make a one-sided and selective investigation favorable to the contentions of the manufacturers against high taxation of business in Wisconsin. There is no doubt that the tax system of the state needs improvement at several points and it might be expected that if the manufacturers' contentions are sound (as they seem to be in some cases) a really nonpartisan investigation where they could present their case to the farmers and other taxpayers and then have their allegations tested by an investigation under joint control would bring good results. This report by the National Industrial Conference Board, made at the request of the Wisconsin Manufacturers' Association, makes no use of a readily available source of information as to which classes of the community are carrying the heavier tax burdens, namely, the income tax returns, which in this state are not subject to a secrecy clause. A sampling investigation, not at all complete, made under the direction of Professor Ely, showed that on a three to four-year average, farmers were paying around 31 per cent of their net income in the form of state and local taxes, and certain public utility corporations were paying as much or more, but manufacturing corporations were only paying about 22 per cent. If these figures hold good for all of the state the tax burden on manufacturers is only about two-thirds as great as it is on farmers. This evidence, which on the face of it overthrows the main contention of the National Industrial Conference Board, might have been looked into under a joint investigation and probably a valuable consensus of opinion, or remedial measures, might have been agreed upon as an outcome. While this report contends that urban centers are being taxed for the relief of rural sections, and that consequently manufacturers are leaving the state or not coming in to the state as rapidly as they should, it might have been worth while to have inquired whether the farmers were not being subjected to much heavier tax burdens than the manufacturers, and whether both manufacturers and farmers might not have united to bring about remedies beneficial to both.

The tax burdens are high on some classes in Wisconsin but comparatively light on other classes. The fact is that the state and local governments have been constructing a system of highways far beyond the state's relative tax-paying power, but, unlike other states with which comparison is made in the report, have been paying the bills, for the most part, out of current taxes instead of bond

issues. The state has also paid for a soldier's bonus and built a state hospital, as it formerly built a state capitol, without issuing any bonds for the purposes, as was done by other states. It is strange, indeed, that this report should make no comparison of the increasing debt burdens of other states with which Wisconsin is compared. It may be that the manufacturers who, it is alleged in the report, are leaving or contemplating leaving Wisconsin for these other states, on account of the lower taxes in those states, will find, shortly after their arrival in those havens, that the state and local debts will begin to be paid out of taxes. Perhaps Wisconsin has been too extreme in its aversion to public debts, but it is always a question whether the politicians, who borrow for public improvements instead of paying cash out of taxes, are really not playing the cheap game of passing the deluge on to the next generation in order to win for themselves the popularity of public welfare without taxes, just as they are charged in this state with getting popularity by loading the soldier's bonus and other special taxes on business. The report mentions the fact that the net indebtedness per inhabitant of Wisconsin is the eighth lowest in the list of all states in the Union (p. 17), but it does not make use of this fact when comparing Wisconsin's taxes unfavorably with those of the notoriously debt-ridden state of Ohio or the other nearby states, all of which are now higher or are becoming increasingly higher than Wisconsin in the list of per capita indebtedness.

A critical study of all the details of this report is hardly worth while in view of the omissions above referred to, and possibly others. I find that the state official figures are correctly copied and added up. I am inclined to sympathize with the objections raised in the report against the progressive income tax and surtaxes on corporations imposed in the state. But I do not know what to think about the validity of any of the contentions when I see a statement (p. 85) that corporations are evading taxes by creating two corporations, a producing corporation located in Wisconsin and a marketing or purchasing corporation located in another state, the producing corporation selling its product "*at cost* or at a *small profit*" (italics not mine) to the holding company outside Wisconsin. The producing corporation, says the report, "pays little or no income tax since it shows little or no profit" (p. 85). An examination of the statutes or a five-minute inquiry at the office of the Tax Commission would have shown that, in such cases, the Tax Commission treats the entire going concern as a unit and prorates Wisconsin's share of the concern's total net income to Wisconsin for purposes of income taxation. I learn that even a foreign corporation, Henry Ford's for example, pays about $100,000 income tax in Wisconsin on account of branches located in the state. And can the authors of this report be so simple as to guess that even a very stupid legislature would let its own domestic corporations escape taxation by creating dummy corporations in other states?

There is no doubt that the tax system in Wisconsin needs a complete and impartial investigation, and that such investigation should include reliable comparisons with other states, but the report of the National Industrial Conference Board does not qualify for admission to that kind of an investigation.

JOHN R. COMMONS

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Seasonal Operation in the Construction Industries: the Facts and the Remedies, by John M. Gries, James S. Taylor, and others. New York: McGraw-Hill Book Company. 1924. Pp. 213+XXX.

This book gives the "report and recommendations of a committee of the President's Conference on Unemployment," and it obviously aims to promote the modification of certain seasonal phases of building operations rather than to make extensive contributions to statistical method. The chief purpose of the book is perhaps not different from that which led Mr. Herbert Hoover to appoint the "committee on seasonal operation in the construction industries." That purpose was, the Secretary states in his foreword, "to determine how nearly it is possible to eliminate the dull seasons which are characteristic of the construction activities." This purpose the book serves well: by assembling a mass of numerical and descriptive facts, by generous quoting from authority, by frequent repetition, and by detailed advice and instructions, it seeks to show that severe seasonal swings in building exist, that much of the seasonal movement is no longer inevitable under modern conditions, and that the public, the owners and the builders can effectively cooperate to reduce building seasonality.

Although the book primarily concerns those interested in the building industry, whether directly or on grounds of public policy, there are certain aspects of the statistical work in the book which will receive special attention from readers of the JOURNAL. The statistical treatment appears mainly in Chapters III–IX, XIII, XIV, and in Appendices A–E.

The reviewer ventures the general criticism that alleged "measures" of seasonal variation are in many instances based upon unduly brief time intervals. The charts on pp. 41, 42 are apparently based upon data for three years—three years in which building activity moved strongly upward. Consequently, a considerable part of the variation shown is not strictly seasonal, but is due to secular trend or the cyclical swing. The case is even less defensible where the seasonal measurement is based upon a single year of data, as in the chart on p. 51, the charts on p. 68, the tables on pp. 172, 173, 177, 180. It may be contended that, in an industry subject to heavy seasonal swings, errors in seasonal measurement due to use of too short an interval may be waived. It is true that such errors, so far as they are due to trend or cycle, may be slight relative to the amplitude of the seasonal dip; but, in series so subject to irregular influences as are building figures, there is an added danger in that some of the monthly items for any one year may be quite abnormal.

Further light on these remarks appears in examining Tables XII to XVIII. The method there used for measuring seasonal variation, while not peculiar to the book under review, is not one of the devices most commonly accepted. It consists, for a five-year period, in dividing the total for the five Januaries by the total for the five years, and so on for the other months. The resulting twelve "percentages of the yearly total" purport to show the seasonal movement. Certain strong objections can be raised against this procedure. The five-year percentage for any month, say January, is a weighted average—the weights being the five yearly totals—of the January percentages for the five years. This

giving of greater influence, in determining the result, to the years which happen to have larger totals is not easily justified. But suppose a simple average of the five January percentages were taken: the effects of an upward trend or a prolonged cyclical upswing would still appear in the "seasonal" index, and irregularly large or small items in the original series would contribute to the distortion. A glance at some of the five-year tables of Chapter VI—perhaps Table XVI is the most conspicuous case—shows how serious these irregular items may be. It may be suggested that no perfect measure of seasonality exists for series so irregular as those of the building industry, but it is believed that there are methods clearly more reliable than that actually used. In any case, in a discussion in which evidence of seasonal variation is used as proof of important assertions, prominent mention should be made of difficulties or imperfections in the measurement of seasonality.

Rather lengthy comment is made upon these questions touching the adequacy of the measurement of seasonality because the very authority under which the book is issued might serve to extend the use of methods which are yet the subject of controversy. The other statistical work of the book is on the whole above reproach. The numerous tables and charts are in the main well planned and carefully executed. Particular attention may well be directed to the charts on pp. 15, 114, 152, and 153, and the tabular presentations on pp. 23–30, 32–33, 36–37, and 66–67. The seven page index covers the topics in considerable detail, and is conveniently arranged. The mechanical work throughout the book is of high order.

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American Agriculture and the European Market, by Edwin G. Nourse, with the aid of the Council and Staff of the Institute of Economics. New York: McGraw-Hill Book Company. 1924.

The Institute of Economics could have turned its energies to no better purpose than a popular interpretation of statistical and economic facts relevant to the present position of the American farmer. Although this book was written before the rise of grain and hog prices in 1924, and before the adoption of the Dawes plan, it sketches in brief space some of the basic tendencies which will have to be reckoned with in any American agrarian policy.

The statistical history of agricultural exports from the United States since the Civil War falls roughly into four periods. The first, from 1870 to 1899, registered a rapid increase. The second, from 1900 to 1914, was marked by a somewhat slower but unmistakable decline. The third, or war period, from 1915 to 1920, was of course one of great expansion. From the middle of 1920 to 1924 a moderate decline in quantity, coupled with a precipitous drop in prices, occurred. The problem which the author sets himself is to discover which of these tendencies is likely to prevail in the near future.

Though his analysis of the causes which brought about the phenomena of the various periods is not thoroughly documented, it will in the main be accepted by

most economists. From 1870 to the end of the century the distribution of free land in this country, coupled with a large volume of immigration, brought about a rapid increase in the volume of crops, at low marginal costs. During the same period the growth of machine industry in western Europe, combined with increased costs of food production, greatly enlarged the foreign market for American farm products. These products were paid for by export of manufactured goods, of capital for our new industry, and by shipping, insurance and banking services. Though our food exports were large in these years, our farmers were not prospering, on account of the low prices which prevailed.

With the new century a period of general readjustment began. The best free land being exhausted, land values rose and marginal costs increased. Agricultural conditions similar to those which had previously existed in the United States were inaugurated or perpetuated in Canada, Argentina, Australia and elsewhere. Our manufactures increased mightily, thus at the same time furnishing a broader home market to the farmers, and cutting off, with the aid of protective tariffs, much of the European imports. Thus Europe found it both cheaper and more practical to buy an increasing part of the necessary surplus from other nations. This need was reduced, moreover, by domestic policies in Germany and France aimed at greater national self-sufficiency in agriculture. In this period of gradually falling exports, American agriculture became a more stabilized industry, and those farmers with the best land and the best management began to accumulate wealth. Better methods and the growth of their home market were setting them on their feet. There was no reason to suppose that these tendencies would change, but rather that the United States would continue to grow in manufacturing industry until it joined western Europe as an importer of foods.

The war interrupted this development. Reduced crops in Europe, shortage of shipping to carry food from the more distant sources, the cutting off of Russian wheat, enormous credits to the belligerents which enabled them to buy with little regard to price—all these things increased the demand on American farmers, raised crop prices, raised land values, brought about a speculative boom and eventual overproduction—in whose creation the propaganda of patriotism aided the normally powerful motive of profit.

In 1920 the farmers were caught by swift depression. Though exports remained large, the prices at which they were purchased fell to pre-war levels, partly because the war and post-war credit had reached the end of their tether. Since that time—until this year—no measures of relief have altered the fundamental situation. We have continued to produce abnormally large crops, except in cotton, since depression in the highly competitive farming industry does little to reduce production except by the slow and painful process of driving farmers off the land. Meanwhile European agriculture has increased its yield, the long-haul competitors are back in the market, and the diminished credit of our best customers beats feebly against the obstacles furnished by their inability to sell us large quantities of manufactures, the high rates of dollar exchange, the high rates of railroads in the United States as compared with those in Canada and with ocean freights from more distant countries.

Those who believe that the Dawes plan or any other financial adjustment will so increase European purchasing power as to furnish a market for our surplus crops will do well to read Mr. Nourse's chapters on the prospect of such improvement. They continue the type of analysis already familiar in other publications of the Institute of Economics, and present a discouraging outlook. It is difficult indeed to see how, even disregarding the war debts, Europe can build up an import surplus equivalent to that which existed in 1914.

The conclusion of the book is, therefore, that those factors which have entered the situation since 1914 will merely emphasize the tendency to reduced agricultural exports existing at that time. Except in years of crop failure, American farmers must look elsewhere than to Europe for relief from their troubles.

It is perhaps a necessary fault of the book that in covering so much ground in such rapid strides it must fail to take detailed account of all the possibilities which might alter its conclusions. It is possible to conceive of a train of circumstances which would shortly render less acute the disparity between European demand and American surplus. If, for instance, the obstacles to the recovery of Russian grain-growing are more deep-seated than appears, if land redistribution and peasant proprietorship in central and eastern Europe result in a permanently reduced surplus for sale, if land values and manufacturing in Canada, Argentina and Australia increase more rapidly than is expected, if ocean freight rates on distant routes rise and American railroad rates are lowered, if a Great Lakes to sea waterway should furnish relief from adverse differential shipping costs, if greater efficiency in American farming should more than offset increasing marginal costs due to higher land values, if European industry and credit make a miraculous recovery—these things taken together might possibly turn the balance. They are, however, outside the scope of reasonable expectation.

The chief deficiency in this study is one implied in its title. Most of our crops are sold, not merely on a European market, but on a world market of which the United States is by far the largest factor, and it is a mistake to assume that alterations in the European demand are solely responsible for American agricultural conditions. Changes in American consumption may cause even greater fluctuation of demand. Though the author does not make this mistake, he comes dangerously close to it in his brief and unpretentious discussion of the crisis of 1920, and the emphasis of the whole book may mislead the unwary reader. No discussion of the European market is fully enlightening unless paralleled by an equally careful analysis of the domestic market. What is the relation between the real incomes and employment of American workers and their consumption of various types of agricultural products? How great are the fluctuations in domestic demand? What is likely to be the influence of economic tendencies, of changes of habit, in this country? Fortunately the Institute promises another volume on such subjects, which must be investigated before fully informed discussion of remedies is possible.

GEORGE SOULE

Dock Labor and Decasualization, by E. C. P. Lascelles and S. S. Bullock. London: P. S. King & Son, Ltd. 1924. Pp. 201

The methods of employing labor along the waterfront in America and in most of the ports of the world are as far behind the scientific and systematic practice of more up-to-date industries as the culture of primitive tribes of the Australian wilds is removed from modern civilization. A ship comes in and needs to be loaded (or unloaded). The foreman of the dock blows a whistle in front of the entrance and summons the men loitering in the neighborhood to assemble on the curb. This crowd forms the typical longshoremen's "shape." In less than ten minutes the foreman selects two hundred men or more and dismisses the rest. No character is required; even the name may not be asked. At the end of the day, or sooner, the men may be paid off. They are not directed to some other dock. They must seek work anew, unless they prefer to wait until another ship docks at the same wharf. Very often they follow the latter course because some impatient foremen do not like to have their men away when they happen to need them. If not available, the offenders may be left standing on the curb the next time they appear in a "shape."

Each dock, under this primitive method, tends to build up a separate labor reserve. It has been shown statistically that the rise and fall in the number of workers on one dock bears no relation to the rise or fall in the others. The consequence of this inexcusably chaotic practice is that although a particular port might never need more than perhaps 20,000 longshoremen on any day if the labor force were properly distributed, the aggregate in the various reserves of available men is likely to be nearer 30,000, mostly underemployed. This is not only economically wasteful but disastrous in other respects. The intermittent work demoralizes the men and brings serious consequences to their families.

It is not too strong an assertion for the authors to make that "the system is opposed to every principle of humanity, and it can neither be defended nor excused." They point out that "It has constantly been discussed and investigated in almost every aspect, and a long series of Royal Commissions, economists, social reformers and labor leaders have competed in violence in their denunciation of its evils." In America the casual system has continued with no apparent sign of reform and the port of Seattle is the only place where a real improvement has been effected. In England, however, important steps have already been taken and significant experiments made. The book deals with these experiments, showing what has been learnt concerning the practical problems met in decasualization and how they may be overcome.

The success in handling what may appear to be details in a scheme of decasualization will determine its success. A paper plan of decasualizing dock labor is perfectly easy to devise. The principles of such a scheme, as already accepted in a general way by the industry in England, would be suggested by most persons who have given the problem some thought. The first of these principles is that under the joint authority of the employers as a whole in any port and the trade union, a system of registering dock workers should be established, so that eventually only registered workers would be employed. This joint authority would deter-

mine the maximum supply of labor needed and would take steps to reduce the reserve by limiting it to the necessary margin. The same authority would be responsible for arrangements to transfer the workers between different docks, so that the fullest possible use of the registered men might be made. Through a preference system the maximum amount of employment would be given a substantial portion of the working force. For the new workers and those at the margin, who are likely to be underemployed, a system of maintenance guaranteeing a substantial minimum of subsistence has been proposed. This scheme disregards numerous complications.

> It is not enough to visualize the casual problem in its simple form of a great mass of men competing for insufficient work among a line of employers up and down the river. Such a superficial view would lead to the equally superficial conclusion, that the problem is little more than a sum in long division, in which so many thousand dockers are to be divided among so many hundred employers. The picture to be conjured up must include, and must give full value to, the different groups of employers, each with its own special needs, the groups of workmen created by necessity or custom, the variety of work and its effect on the fluctuations of the demand, and the unwieldy layout of the port, with its docks and wharves constructed haphazard without any regard to the organization of the efficient whole (p. 15).

Aside from the technical factors, there are the human difficulties—inertia, tradition, suspicion, misunderstanding, blind opposition, unwillingness to cooperate and other elements. It is with these that this study of decasualization deals principally. Thus the picture which the authors construct for us is one in its natural setting, in which the problem is altered from one of long division to a tangled calculation needing ingenuity and infinite patience for its solution.

It would be too long an account to enumerate all these human difficulties. How can registration be instituted when the workers themselves blindly oppose it? How can the lists be reduced after registration has shown an extremely excessive labor reserve? Elaborate systems of surplus stands and telephone boxes for distribution of labor have failed. How get the foremen to use these telephone boxes and how induce the workmen to go to the surplus stands? How make employers get into the habit of calling for surplus workers from other docks, and how best secure the acquiescence of the workers in these transfers? Assuming maintenance to be an accepted principle, how shall the money for this be raised and apportioned?

The book discusses these problems separately and also in connection with the history of the experiments in various ports. In London, as a whole, registration of dock workers has been begun but dock labor has not been decasualized as yet. In one section, however, that under the Port of London Authority, employing about 7,000 of the 50,000 dockers in the port, the progress has been notable. The Authority was created by the Port of London Act, 1908, as a result of the financial difficulties of the London and India Docks and others. The Act resulted in having the dock companies bought out and transferred to the Authority, by whom they are managed. The Authority inherited a method of hiring labor which has for two decades made the London and India docks the one bright spot in so far as decasualization is concerned. The progress from haphazard methods is seen in the testimony of an official of the Company, in 1905, that at one time every de-

partment had been regarded as a separate unit, so that each of the 45 departments in the establishment hired and fired its own men. Later each dock came to be regarded as the unit and finally the docks as a whole came to be treated as the unit.

As a result of gradual development, the Authority's docks now employ about 4,000 men permanently, paying them on a weekly basis, granting them a week's annual leave as well as statutory holidays. The rest of the labor force consists of "B" men and casuals, sometimes referred to as "C" men. The "B" men have tickets which entitle them to preferenital treatment by the Authority when no permanent men are available and before any casual men are engaged. They number less than 3,000. The casual men appear on no list and are drawn from the margin of casual labor in the port as a whole. But the Authority claims that under normal conditions only two per cent of the men belong to this casual group, so that substantial improvement has been made in the lot of workers employed by the Authority as compared to those in the rest of the port.

Plans of decasualization taking in a port as a whole may be said to have been started with the Liverpool dock scheme of 1912. The initial difficulties were serious and in some respects the scheme has not justified the hopes of its founders. But the plan has had many valuable results and has closed the door to a general influx of unemployed labor into the port. This scheme is described in detail, as well as the plans in a number of other English ports. Here are seen the extent to which the difficulties discussed have interfered with the workings of various features of the decasualization plans. The lack of interest of the employers, the opposition of foremen, the resistance of the workers are shown at each turn. The most commendable stand of all seems to have been that of the union officials, particularly Mr. Bevin, who for years have fought the battle within the union and without, for a system of employment along the waterfront which would make longshore work a dignified trade instead of a catch-all for the derelicts of other industries.

The chief reason why success has not been greater is clearly seen by the authors of this book. In a chapter on "The Necessary Basis of Reform," they show that all the elements of a decasualization plan are dependent upon some scheme of maintenance of the men who receive insufficient employment, which would provide a direct financial incentive to the employers to save money through the efficient management of labor. In their own words: "Experiments in the past have failed because there was no inducement to either employers or dockers to make them succeed. . . . . If some real financial incentive could be attached to registration, punishing impartially the pockets both of employers and dockers if they prevented the deflation of the register or refused to join in schemes for labor distribution, then the machine would acquire that force and precision which it now lacks. . . . The solution, in fact, seems to lie in making maintenance the financial incentive which will give life and vigor to registration" (p. 122).

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The Integration of Industrial Operation, by Willard L. Thorp; Census Monographs III, Bureau of the Census, United States Department of Commerce, Washington, Government Printing Office. 1924. Pp. 272.

Certain features of the development of the industrial organization in the United States during the first twenty years of the present century have been discussed by Dr. Thorp in No. III of the series of Census Monographs. This volume, prefaced by an introductory note by the Director of the Census and a foreword by Dr. Wesley C. Mitchell, can, for the most part, be termed a by-product of the administrative activity of the Census Bureau, being a presentation of data that was obtained for administrative purposes only without any thought of their utilization as the basis of a statistical study.

The book concerns itself with two major problems; changes in the proportions of the production coming from large and from small establishments, and the development of operating combinations, *i. e.*, the number of separate plants operated through one central office. Part I is given to the consideration of the first problem, Parts II and III to the second.

In Part I, "The Growth of Industrial Establishments," the point is made that the industrial revolution which began to show itself clearly in American industry some fifty years after it had been under way in England is still going on with resultant social problems in adjustments. There is a good description, largely based on Census material, of the emergence of the factory system in the United States with the emphasis laid on the developments of the past twenty-odd years. Four conceivable methods of measuring the size of establishments are noted: (1) the capitalization involved, (2) value of products or value added by manufacture, (3) number of wage-earners employed, and (4) physical product per establishment. For his study the author entirely discarded the first method because of its inadequacy and used the remaining three, the last two whenever possible, with the value of products substituted for the physical product when no figures on that subject were available. A study of all industries combined reveals some trend towards larger establishments at the present time. This is due to the inclusion in the average of some rapidly growing new industries which require large establishments for profitable operation such as automobiles, rubber-tire, beet sugar and electrical apparatus enterprises. The author reaches the conclusion, however, that "the census data certainly cannot be used to support the hypothesis that the tendency for industrial establishments since 1900 has been, in general, to increase in size. The rapid concentration, so evident in the nineteenth century, is by no means so marked in the twentieth" (p. 45).

A detailed study is shown for establishments in 18 selected industries, in some of which notable increases in average size were evident, in others a more nearly constant level in size was maintained, while in still others there appear tendencies to a decrease of the average size. There is a discussion of the changes in the scale of production in establishments as measured by the number of wage earners. Another method followed for measuring the scale of production is by the value of the product. On pages 86–89, the author sets out in considerable detail his views on the advantages of large scale production and also points out the types of

establishments which do not lend themselves to it. He summarizes the discussion on changes of size in the following words:

> Until 1914 industry as a whole showed but little tendency toward an increase in average size of plant but there was a noticeable growth from 1914 to 1919. Those developments present are chiefly the result of an unusually rapid expansion of certain industries in which production is carried on in large establishments and the more nearly complete utilization of plant in the abnormal year of 1919. There is no adequate measure of increase in the industrial capacity of establishments.
>
> Throughout industry as a whole no general tendencies of growth can be found. Although the number of large-scale establishments is rapidly increasing, the size of establishments at any given moment varies to a marked degree from industry to industry and from period to period. The problem of the scale of production, therefore, is one of particular industries and even of particular periods, the factors entering into each situation being often very difficult and always very numerous (pp. 89–90).

In relation to the changing character of ownership the author points out that while the greatest *number* of establishments are operated by individuals the most significant figures are those which show the industrial activity of the corporations. Although including in 1919 only 31.5 per cent of the establishments, they employed 86.6 per cent of the wage earners, and manufactured 87.7 per cent of the total value of the products. Establishments operated by corporations employed an average of 86.1 wage earners per establishment, while those operated by individuals employed on the average 4.5 wage earners.

In his discussion of central office data—Part II, "The Extent of Central Office Operation," and Part III, "The Structure of Central Office Groups"—the author makes it clear that his study has been confined to *operating* combinations and is not directed to the *financial* combination feature. By definition a central office group exists when two or more industrial establishments are operated from a single central office. The central office may act in practice as a sales agency, but it is the actual directing force in the activities of the various constituent establishments.

Dr. Thorp discusses, in turn, the extent and size of central office groups; their industrial specialization, including the complexity of central office combinations in the manufacturing field and their activities in non-manufacturing fields, and the geographical distance of the central office from its controlled establishments. He analyzes the central office groups by nature of products such as uniform products, joint products, by-products, dissimilar products of similar processes, complementary products, auxiliary products, dissimilar products for the same markets, successive products, and unrelated products. The following extract briefly gives the general conclusions drawn in Parts II and III.

> The census records indicate that at least 7.8 per cent of all establishments are found in central-office groups. It is probable that more than one-third of all wage earners engaged in manufacturing are employed by them, and that they produce a similar proportion of the total product of American factories. These combinations vary from concerns operating 2 mills to groups of over 100 establishments with activities in foreign countries as well. The distribution among industries is very wide. Nearly all lines of activities are represented, and many combinations extend outside the manufacturing field, particularly into mining operations. The establishments are often widely scattered geographically, a

development which has only been made possible by the modern means of rapid communication.

Of these central office combinations approximately five-eights are simple in nature, operating establishments all of which are found in a single industry. With the exception of a very few instances, the remaining central-office groups were shown to have a rational functional basis for existence. The greatest number of complex central-office groups were found to operate establishments producing successive products—a type of organization often called "vertical" or "backward integration." Second in number of instances were the combinations which produced joint products—cases of diversification based upon the exploitation of a single material. In the third place were the central-office groups in which different types of establishments are included because they all produce for the same market. In the remaining types of functional organization fewer instances were recorded, yet sufficient in number to justify the existence of separate categories for manufacture of complementary and auxiliary products, by-products, and the operation of establishments exploiting a single process.

In conclusion the author points out the path for further work along these lines as follows:

> There are at least three directions in which this study should be extended. These further studies should be: First, a study of central-office organization in terms of wage earners and value of products determining the importance of such combinations in all industry, and the value of central-office management in terms of regularizing employment, etc. Second, a study of secondary or subsidiary products within establishments, and the relationship of central-office organization to the utilization of waste. Third, the extension of the study of industrial operation to include industrial control, thereby admitting financial and other bonds which unite industrial ownership. If this study has served to present a series of problems and indicate to some extent a method of analysis, it has accomplished its purpose (p. 268).

In general comment it should be said that the book is written in a clear style and that the author has been successful in developing from a mass of details a number of fairly clear-cut conclusions. In work of this kind some qualification of broad generalizations is unavoidable but this book is characterized by a sense of proportion which does not give the qualifications undue prominence. At a number of places long detailed discussions are admirably summed up in a few words. Of particular interest to many readers will be found the detailed discussion of the conditions of the different industries appearing in Part III, and the author has done well with his painstaking interpretation of each industry's figures in the light of the particular conditions relating to that industry.

DAVID L. WING

Studies in Human Biology, by Raymond Pearl. Baltimore: Williams & Wilkins Co. 1924.

Statisticians and public health workers who have followed the stimulating contributions from the laboratory of Professor Raymond Pearl will be interested in this recent book of 653 pages. This is essentially a collection of edited reprints of the author's valuable papers on various phases of biometry and vital statistics with the addition of three chapters which embody material published for the first time.

The book is divided into four parts: (1) Considering man as an animal; (2)

Biological Aspects of Vital Statistics; (3) Public Health and Epidemiology; and (4) The Population Problem.

Dr. Pearl's important studies of factors of age, race, sex, and longevity are included here, together with his statistical investigations concerning the incidence and epidemiology of influenza, his analysis of the nation's food supply, and his valuable contributions to the analysis of population growth.

Two of the new chapters appear in Part 2, the first of them dealing with trends of vital indices among different race groups. In this chapter the author discusses the biological factors which underlie growth of population, and analyzes somewhat in detail the question of the trend of the vital index of several components of the population. Data presented for the original birth registration states indicate that the vital index has tended to increase for the native born population and to decrease for the foreign born population in the period from 1915–1921 inclusive. It is suggested that the major cause of certain of these trends is a more rapid decline of death rates than of birth rates in the period. It is encouraging to learn from the writer's deductions that the native white populations seem generally to be in a period of biological improvement, judged by the vital index. Those interested in the immigration problem should note, however, that the foreign born whites are on the contrary displaying progressively less biological vigor by the same criterion.

The second new chapter deals with the influence of physical activity upon mortality. On the basis of comprehensive statistics of occupational mortality, evidence is advanced to indicate that among occupied English males "there is a direct and positive relation between the magnitude of the age specific death rates from age 40 to 45 on, and the average expenditure of physical energy in occupation," and that this relationship prevails whether the labor is performed chiefly indoors or chiefly outdoors.

The third new chapter deals with the growth of human populations. This is a continuation of Dr. Pearl's extensive studies of population growth. Considerable evidence is submitted for sixteen different countries, for one city (with reference to studies of a second city) and for the world as a whole, which indicate the validity of a theoretical curve for human population growth. In these studies consideration has been given to many important factors, as cultural conditions, racial composition and industrial development.

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Diagnosing the Rural Church, by C. Luther Fry. A Study in Method. With a Foreword by Franklin H. Giddings. New York: George H. Doran Company. 1924.

The man who went about Zion and counted the towers thereof would assuredly rub his eyes at this spectacle of the application of modern statistical methods to a part of present day Zion. This book is published in the town and county series of the Institute of Social and Religious Research. It represents one of the first

fruits of statistical technique utilized in the analysis of the religious institutions of a number of rural communities in the United States. While limited for material to certain simple data, such as membership figures, financial reports, and records of church attendance, the author has nevertheless been able to draw out of these presumably dreary sources certain very illuminating and suggestive conclusions.

The late lamented Inter-Church World Movement, as one of its less conspicuous services, collected information of a statistical sort concerning the rural church in 1,000 of the 3,000 counties of the United States, and definitely completed its survey of several hundred of them. Certain of these, geographically well distributed, were chosen by Mr. Fry from this group to be the subjects of analysis. Where there was any question of the reliability of the original data, and whenever it seemed best to bring the data down to the present, a special resurvey was made of the particular counties. As the author points out, material collected for another purpose is somewhat less satisfactory than material gathered for the specific ends set by the investigator. Nevertheless it is fortunate that data of so reliable a nature and an investigator of ability should have been brought together.

The study, which concerns itself only with Protestant churches, falls into three main divisions. In Part I there are developed methods of measuring churches, which involve membership and contributions, the old and familiar tests, and a new one, attendance. Part II is concerned with the discovery of factors accounting for the findings of Part I, factors in the environment, and in the churches themselves. Part III utilizes a totally different set of data; it studies Windsor County, Vermont (investigated earlier, 1910, by Gill and Pinchot and reported in their book "The Country Church") with the aim of comparing the churches of one county at three different points in time. This shift in material studied does not affect the unity of the present work, but rather rounds it out.

The several standards of measurement are applied in Part I to 32 counties, distributed among 26 states, chosen for their representative rural character, and for their geographical variety. Every section of the United States is represented as fairly as the limited sample will permit. The 1,364 Protestant churches with 116,477 resident members are 1.3 per cent of all the rural Protestant churches in the United States and the counties in which they are found have 1.2 per cent of the town and country inhabitants of the United States and include 1.1 per cent of the area of the United States. The "money measure," per capita annual contributions of members is shown to vary by counties from $7.27 to $37.55. By graphic methods and by correlation coefficients the direct and high concurrence of degree of income and wealth of counties with per capita contributions is clearly shown. Nor are the data crudely handled: numerous analyses by village and open country groupings, by racial distinctions, etc., impress the reader with the author's evident desire to eliminate factors of selection. The author concludes that the cash contributed by members is not a fair index of religious interest. The "membership measure," carefully refined on the basis of the size of the populations in the several counties actually to be counted as potentially capable of Protestant membership proves also to be a defective index of interest. Indeed

the correlation of membership ratios with average time contributions of members is $-.59 \pm .08$. The "test of attendance" is the mean time contribution per month of the Protestant population of the county, not of the active members alone. It is in Mr. Fry's opinion the best measure of the interest of a county in the church. Certain interesting conclusions reached are that this measure is less variable than the ratio of active membership to total Protestant population; that the correlation of these two is $+.91 \pm .02$; that the correlation of attendance interest with the total white density of population is $+.37 \pm 10$; that for attendance interest with average individual contributions it is $-.21 \pm .11$.

In Part II other correlations are developed, to ascertain the factors affecting attendance interest; as, for example, between attendance interest on the one hand, and, on the other, average farm values, growth and decline of population, racial composition, and occupational distribution. Within the churches themselves are other factors, affecting contributions and attendance interest, such as the size of the congregation, the presence of a resident pastor, the use of orderly financial systems for collections of church funds. Some very interesting conclusions are drawn as to the possible effectiveness of certain types of church program in the face of conditions within and without the churches.

In Part III there was revealed a notable change in the situation of the churches of Windsor County, Vermont. While membership and contribution had shown no remarkable decline from 1888 to 1922, the attendance index fell 50 per cent.

Enough has been presented to suggest that here is a very capably handled statistical study. The reviewer, however, is moved to wonder whether the tests of linearity have been applied to all the correlation coefficients, because the simple bar diagrams do not always show a straight line relationship between the variables (*e. g.* Charts IV, VII). Of course the sample—in number of counties—is very small, and admitted to be so by the author. But accuracy of data has not been sacrificed to a low probable error produced in part by a larger sample of less accurate material. As a beginning in this field of application of statistical method Mr. Fry has made a very useful and intelligent contribution, upon which we hope more extensive studies with larger samples may be modelled.

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Problems in Business Economics, by Homer B. Vanderblue. Ph.D. Chicago and New York: A. W. Shaw Co. 1924. Pp. xix+631.

This volume forms a valuable addition to the list of texts for the use of present or potential business executives. Its contents cover three distinct subjects. The first section furnishes an admirable condensed statement of what we know or believe to be true about the business cycle. The second part of the book tells the student or business man about the methods and findings of the Harvard Economic Service. In a supplementary chapter full instructions are given for applying to any individual business the methods worked out by Professor Warren M. Persons —the purpose being to enable the business man to contrast the fluctuations in his own enterprise with those of the industry in general. While one may question in

many cases the advisability of using the Harvard method for eliminating seasonals and trends, there is little doubt that the clear and simple way in which the method is illustrated by Professor Vanderblue will enable the subscriber who is so inclined to secure from the reports of the Harvard Economic Service much more benefit than he could hope to obtain without the aid of such a guide.

The third section of the book contains a collection of cases illustrating problems in the control, operation, and financing of industry and in the distribution of the products. Professor Vanderblue is to be warmly congratulated not only upon gathering together cases illustrating such a wide range of perplexing business puzzles but also upon the skill shown in presenting the facts in an entertaining manner. The cases cited are so thought-provoking that the student will find himself interested as soon as he starts to read. It seems to the reviewer, however, that the teacher's work would have been lightened if care had been taken to state in every case the question to be answered. In the majority of instances this is done; but there are numerous exceptions to the rule.

The problems cited are so puzzling as to give rise to a suspicion that, while their study is certain to prove stimulating, it will be impossible to obtain any unanimity of opinion as to what particular solution is correct. The fact that one course was successful in meeting the issues of 1920 to 1922 does not necessarily prove that the same policy will be the correct one in 1926.

The book contains many tables of monthly chronological data useful both for illustrating the problems stated and as raw material for exercises in statistical method. The volume is a workmanlike product which cannot fail to reflect distinct credit on its author and which will be welcomed by teachers presenting courses in business economics.

WILLFORD I. KING

Flushing, New York

Charts and Graphs. An Introduction to Graphic Methods in the Control and Analysis of Statistics, by Karl G. Karsten. Introduction by Carl Snyder. New York: Prentice-Hall, Inc. 1923.

Mr. Karsten's book is the latest contribution to the field of graphic methods; 724 pages make text and illustrations.

The simplicity of the author's style will be welcomed by those who have attempted to familiarize themselves with graphic methods, but who have been discouraged by a presentation bristling with difficulties. Mr. Karsten has made it his aim to talk in simple terms as far as possible; whenever mathematical phases are approached he gradually ascends the road familiarizing the student with the more technical terms and methods while progressing, thus securing a pedagogical and psychological advantage.

Mr. Karsten makes it clear in his preface that the book follows a philosophic and not an encyclopedic arrangement. Based on this statement the text is divided into Book I, simple charts; Book II, advanced charts; Appendices A to I and the Index. Part I of Book I, entitled "Non-Mathematical Charts" contains a chapter "Maps and Diagrams." If the author ignores the mathematical

element of map projection this classification may pass; however, on page 6 we find reference to twenty-five different map projections as listed in the *Encyclopedia Britannica* and the mathematical projection element of maps being described in this chapter in general terms leaves the classification of maps as non-mathematical charts open to criticism. In this chapter or Chapter LII mention should be made of the homalographic projection of Professor J. Paul Goode of the University of Chicago, which represents a noteworthy contribution to economic geography and modern cartography.

In the chapter, "Route-charts," page 29, Figure 25, the value of popular presentation of this example cannot be analyzed without the proper key. A full description of this chart can be found in the *Inland Printer*, August, 1924, page 757, "Planning, Designing and Selling an Advertising and Merchandising Campaign" by R. E. Ramsey. In contrast to Figure 25 we find on pages 30 and 31 two route-charts which, having proper legends, convey the underlying principles much better.

The resultant of the chapter "Statistics" is the author's commandment: "It is therefore an obvious but extremely important rule not to begin a graph until statistics have been carefully examined and their object or significance brought clearly into mind." This statement should find a place on the desk of every statistician who makes use of graphic presentation.

The chapter "Work Sheets" has many good suggestions. Special reference should be made to Figure 44 on page 60 which shows a basic layout for a statistical compilation. Column symbols, formulae and classified stubs and captions are well arranged.

In Chapter IX, entitled "Hundred Per Cent Bars," we find on page 85, a fine example of a classification chart and 100 per cent bars.

The pie-charts which are treated in Chapter X are of psychological value as the author correctly states. This is especially true of Figure 74 on page 92, where the percentage difference of individual years shows a pronounced contrast. However, as the author will agree undoubtedly, Figure 77 is of little value for comparison by means of graphic presentation. Such data are better shown in a table than in the form of pie-charts.

A pictorial bar chart shown in Figure 117 using a pointer suggesting the dial of a pressure gauge has little value but Figure 114 shows a design by Mr. C. van de Wall which is by far the best example of pictorial bar charts given in this chapter.

Under the heading "Composite Charts" a comparison has been made in Figure 178, page 199, between the number of patents issued during the Civil War and during the World War. It seems that better comparison could have been obtained by introducing the per capita element. As the chart stands it seems of little analytical value to the statistician.

Figure 183 on page 204 is heralded by the author as an "excellent adaptation of the zone curve." With this we agree, but the omission of the zero line and the basis on which prices were computed makes this chart defective. Furthermore, curves should not run into the space reserved for the legend. It is the observation of minute details which makes a chart and basic information should not be

severed from it. Figure 247 is a very good example of detailed chart execution, having all the necessary data on it.

Figure 215 on page 237 shows "Seasonal Fluctuations in Building Operations." The subtitle reads: "Total for 25 states in average year 1910–1920." It must be assumed that all values for January, 1910–20, for February, 1910–20, etc., have been averaged but the subtitle does not bring out this fact. The scale caption reads "Millions of Dollars" in addition to six zeros shown in the scale units. The scale should read either 50; 100; 150; etc., millions of dollars, or 50,000,000; 100,000,000; 150,000,000 dollars, the first way being the better one. The curve should start in the center of the space allotted to January and end in the center of the space given to December as the values represent averages.

In the chapter on "Zee Charts," an unfortunate name for this type of graphic presentation, the author calls attention to the fact that this form of chart may be used for operation control; and, although in the author's opinion "these various methods have not been so successful as to find general acceptance" it is surprising how many industrial establishments use this type of chart today in their planning departments.

The graphic operation control was early recognized; Emile Levasseur read a paper "*La Statistique Graphique*" on June 23, 1885, in London, on the occasion of the jubilee meeting of the Statistical Society in which he says: "*Le graphique peut être aussi un instrument de contrôle. Quand les chiffres sont alignés en colonnes, il n'est pas toujours facile de juger s'ils concordent. Quand ils sont transformés en graphiques, les moindres irrégularités du dessin sautent aux yeux: il ne reste qu'à chercher si l'anomalie résulte d'un changement réel dans l'intensité de phénomène ou d'une erreur de la statistique.*"

"Logarithmic Frequency Curves" is the name of Chapter XXXVII. This section shows in detail the application of the logarithmic scale to frequency distributions. In Figure 363, page 439, an extremely asymmetrical U-shaped distribution is brought to symmetry by the logarithmic scale method. Notes explaining the analytic features of a chart as shown in Figure 363 are always welcomed by the student and it would be highly desirable to incorporate a greater number of them in the next edition of the book. On page 700 the author himself recommends the addition of explanatory notes which will help to interpret the significance of a chart.

For those who make use of the normal curve of error and probability curve Mr. Karsten has contributed some twenty pages on this subject. To get the full significance of their contents, the beginner in graphic methods will do well to read other contributions on this subject in conjunction with Mr. Karsten's book.

In Part V, entitled "Calculating Charts," a full description of how curves can illustrate a mathematical statement is given. Furthermore we find abundant reference to nomographic charts, slide rules and hundred per cent triangles. Figure 429 and Figure 465 show poor and partly defective reproduction and it seems questionable whether typewritten legend work is suitable for reproduction in reduced printed form.

The author refers repeatedly to Professor Lipka's work, *Graphical and Mechanical Computation*, but no reference is made to Maurice d'Ocagne who published

his *Traité de Nomographie* in 1899, his first researches having appeared in 1891. He is considered the real creator of the nomography, although Leon Lalanne, a Paris engineer, published his *Anamorphose Logarithmique* in which he explains the first principles of nomography as far back as 1842.[1] These historical facts seem just as important as the reference to Napier and Mercator.

Two and three dimensional data are treated in Part VI with a revival of a chapter on maps referring especially to such phases of graphic presentation where the map and element plays an important rôle. Six appendices and an index complete the book.

Mr. Karsten's book represents a contribution to the literature of graphic methods. Much of its contents will compensate for gaps in other publications on this subject and therefore the book will find a place in the library of every student of graphic methods.

R. VON HUHN

Washington, D. C.

Investment Banking in England, by Bradley D. Nash. Chicago: A. W. Shaw Company.

The Investment Trust, by Lawrence M. Speaker. Chicago: A. W. Shaw Company.

These two volumes are the winners of the Chicago Trust Company competition for "research relating to business development and the modern trust company." Though monetary and banking theory have received more than ordinary attention from economists, past and present, and deductions drawn from observation of the money market have exercised possibly too great an influence in the development of general banking theory, yet the inadequate nature of our knowledge concerning financial institutions as they are integrated into the business structure confronts the student of financial and business phenomena at every turn. The endowment of research into the various phases of the trust company in its relation to business, therefore, augurs well for an addition to our surprisingly limited knowledge of the activities of this important and interesting modern institution.

Mr. Lawrence M. Speaker, winner of the second prize, has brought together in *The Investment Trust* a wide range of material, both historical and statistical, relating to the investment trust as it is found in Great Britain. In addition to its origin and development, he discusses the typical forms of organization and operation which have been found most successful and with these compares such similar enterprises as have appeared in the United States. Though he has limited himself to a purely descriptive treatment of the subject, Mr. Speaker has produced an adequate, readable volume that is particularly timely in view of the present wide-spread interest in foreign investment in this country.

Investment Banking in England, by Mr. Bradley D. Nash, winner of the first prize, attempts not only to analyze the various institutions of the British investment system, their organization, methods of operation, and functions, but also

[1] *Graphical Methods*, W. C. Marshall. McGraw-Hill, 1921.

to present an historical summary of their origin and growth. Though the study is rather poorly organized and somewhat redundant, its chief failure lies in the ambition of its program. It would seem that before a general summary, historical, analytical, and critical, of the entire British investment structure can be condensed to the practical limitations under which a research competitor must work, there should be many more such modest studies as that by Mr. Nash to break the ground.

WINFIELD W. RIEFLER

Washington, D. C.

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